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ABSTRACT

This project has four major objectives: (1) the design and implementation of a computer-based planning and budgeting system oriented toward educational programs, (2) the design of a management information system focusing on educational programs, (3) a general design for a system to evaluate educational programs, and (4) the integration of the above elements into a comprehensive management system. The resulting simulation model enables administrators and teachers to assess the alternative educational programs and policies by displaying their consequences in terms of resources expended. (RA)

A COMPUTER BASED PLANNING AND MANAGEMENT INFORMATION SYSTEM:

A PILOT IMPLEMENTATION AT THE YORK BOROUGH BOARD OF EDUCATION

YORK BOROUGH BOARD OF EDUCATION

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ONTARIO INSTITUTE FOR STUDIES IN EDUCATION

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SYSTEMS RESEARCH GROUP

November, 1970

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II

PREFACE

The work described in this report is part of a larger project entitled "Systems Analysis for Educational Management". Drawing broadly upon the analytic ideas of systems theory, this project studies the management of school systems and aims to improve the quality of education provided in them by making educational decision-makers more aware of their objectives, of alternative programs for achieving them and of the consequences of their previous decisions. In phases of its work now completed, this project has focussed on creating a computer-based information system and simulation model now named CONNECT/CLASS. This model enables educational decision-makers to determine quickly the economic consequences of implementing alternative policies and programs in a school system and to predict the costs of these alternatives over five year periods.

Public concern about education has reached a peak coinciding with new highs in education expenditure and social demand for schooling. At the same time, there is a widespread feeling among educators and citizens that current social and economic conditions are forcing school systems to make critical decisions about who should receive education, how they should obtain it and what ends it should serve. It is understandable, then, that outside interest in this project has increased as awareness of its aims and achievements spread. This report stands as a working document intended to meet the growing demand for information about the project but not to make a general assessment of its achievements or even of the phases which have been completed to date.

In issuing this preliminary report, we know we run the risk of having the usefulness of designs misjudged on the basis of early prototypes which do not incorporate the features of full working models. Thus, we must make clear that this report covers work aimed at testing designs that meet some but by no means all of the objectives of the overall study. Specifically, the project has

completed preliminary designs for the CONNECT/CLASS model which simulates the resources of school systems and permits educational decision-makers to test the effects that alternative educational policies have on these resources. As with most technological innovations, interest in CONNECT/CLASS runs high. While we welcome this interest, we caution readers to recognize that the analytic tool described in this report is still being developed and tested. And they should know we recognize that technology alone cannot solve educational problems. It is only when technology like that embodied in the CONNECT/CLASS model is used within a framework of educational objectives and programs for achieving them that educational decision-makers can use such tools effectively.

Research and development on the CONNECT/CLASS model is being carried out by the Systems Research Group and the Department of Educational Administration of the Ontario Institute for Studies in Education. The York Borough Board of Education in Metropolitan Toronto is providing the laboratory for this work and the active co-operation needed to narrow the gap between the possibilities of theory and the realities of decision-making in a large school system. We look forward to the additional work needed to bring the CONNECT/CLASS model to full operation and to new phases of the project in which the model will be used in conjunction with program budgeting and evaluation.

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November, 1970

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1. INTRODUCTION

During the past decade, public awareness of long-standing problems in education has increased to the point where it is commonplace to speak of the crisis in schools. The makings of this crisis are found in the wide differences in educational opportunity that schools provide for children, in the discrepancy between public expectations of schools and their actual performance and in the lag between typical school practice and that possible with new curricula, materials and technology. Despite awareness of these problems and the ready availability of strategies to deal with them, schools have changed little through this crisis. Exceptional schools and school systems are perhaps more common, but the broad spectrum of school practice is still like that of a decade ago. A large proportion of pupils--one million Canadian children, according to a recent report--are still poorly served by educational programs--either because their talents are under-developed or scarcely developed at all.

While the roots of this problem may lie in economic and social conditions beyond the immediate control of schools, major improvements in educational performance could be made if schools were able to manage better those resources now available to them. This analysis highlights two kinds of managerial inadequacy. First, school systems are unable to implement readily policy changes in educational programs, despite the apparent control these systems have over large-scale resources. Secondly, schools lack the scope and autonomy to make significant decisions about programs since resources to support them are controlled centrally. Compounding these managerial problems are the lack of clear educational goals in school systems and the absence of criteria for evaluating program effectiveness.

Another way of stating the problem is to say that the educational systems of the next decade must be able to create and manage change. In doing so, they must meet social and intellectual needs of society and of individuals within it; they must develop new programs for meeting these needs by bringing to bear the best fruits of educational research and innovation--and yet keep costs within tolerable bounds.

1.1 The Development of Systems Analysis Techniques

Some two years ago, the Systems Research Group and the Department of Educational Administration of the Ontario Institute for Studies in Education undertook a project to study these problems and to design solutions to them. The project, "Systems Analysis for Educational Management", started with a review of systematic models for planning in schools and assessed the success of other current projects in implementing such models. This review is now being prepared for publication under the title "School System Management: A Review of Planning Models and Technology". In other activities of the initial phase, project staff surveyed two large school systems[1] to identify information flow patterns in these systems and to define the implicit decision-making models on which these systems operated. Data were collected through interviews and observation in the major areas of school system operation--budgeting, program development and evaluation, staffing, building and other aspects of short and long term planning. Working closely with administrators in these school systems, the project staff graphed each

1 The York Board of Education and the Hamilton Board of Education

decision-making area as a flow diagram and developed a tentative model of administrative decision-making in school systems.

A comparison of decision-making models used in these school systems and those based on systematic planning suggested that there was still a considerable gap between the two. The decision was made to extend the work described above and to narrow the gap between theory and practice in educational management by developing a computer-based planning and budgeting system into an operational form. The York Board of Education was chosen for the pilot project.

Specifically, the objectives of the project were as follows:

a) design and implement a computer based planning and budgeting system oriented towards educational programs and objectives,

b) design a management information system focusing on educational programs--their objectives, resources and effectiveness,

c) develop a general design for a system for the evaluation of educational programs,

d) integrate each of the above elements into a comprehensive management system.

1.2 The Implementation of Systems Analysis Techniques

Building on the experience gained in the development of the CAMPUS[2] models, the Systems Research Group developed CONNECT/CLASS: a computer-based system designed to Connect the user to a tool for Comprerehensive Long-range Analysis of School Systems. The CONNECT/CLASS simulation model has the capacity to represent the structure of the system--the schools, the programs, the activities that make them up, the resources in terms of staff, equipment, space and facilities required for given enrolments, instructional designs, teaching methods and administrative policies.

The model enables administrators and teachers to assess the implications of alternative educational policies and programs by displaying their consequences in terms of resources expended. The model does not replace professional decision-making as educators still have to use their judgment as to whether expected program benefits are worth the resources allocated to them.

To facilitate programming and budgeting as required in the general planning model, the CONNECT/CLASS information system is designed for the school system as a whole. This system provides flows of organized information to educational decision-makers about the operation of

2 CAMPUS--Comprehensive Analytical Methods for Planning in University Systems. See R.W. Judy and J.B. Levine, A New Tool for Educational Administrators (Toronto: University of Toronto Press, 1965); and Systems Analysis of Alternative Designs of a Faculty (Paris: OECD, 1968).

programs--their resources and productivity--and thus increase the capacity of decision-makers to develop and manage these programs.

Since the basis of this information system lies in educational objectives and programs to achieve them, the intention was not to develop a system that can be used for day-to-day enquiry such as the California Education Information System. The emphasis was on structuring the flow of program-oriented data within schools and from schools to the school system thus necessitating designs for collecting, processing and reporting these data.

To complete the requirements of the CONNECT/CLASS system, criteria of educational productivity and procedures for applying them to evaluate the effectiveness of instructional designs, methods, policies and other elements of educational programs are being developed. In addition to the plentiful measures which schools now employ to assess individual pupil achievement and to augment the judgments of teachers and administrators on program effectiveness, criteria will be employed based on the success of pupils in later educational and work experiences and on the opinions of parents, pupils and community agencies.

The aim here is not to displace the mature judgment of educators, but rather to buttress them with research-based analysis and wider social attitudes. This approach should improve current evaluative practices and lay the basis for more comprehensive studies of the problems.

1.3 Objectives of this Paper

Many papers have been written about the concepts of systems analysis and Planning-Programming-Budgeting Systems. This paper will deal mainly with how some concepts of systems analysis may be applied in actual operations, particularly:

1. the definition of objectives,

2. the development of a program structure, and

3. simulation analysis of school systems.

2. OBJECTIVES IN EDUCATION

2.1 The Need for Objectives

During the past fifteen years enrolment in educational institutions in Canada has been steadily increasing along with the pressure for more facilities, space, and staff to meet these needs. Education costs, the largest single item of government spending, are estimated to rise to almost eight billion dollars by 1975. The Economic Council of Canada now stresses the need to improve quality, which has previously been sacrificed to quantity, in terms of new facilities.

It suggests that in the 1970's "the central focus of education policy should increasingly shift to improving quality and efficiency, especially at some of the weak points in our educational systems. To do this it will be necessary to acquire a better understanding of many aspects of the educational process."[3]

Since educators face the problem of unlimited objectives and constrained resources, they must be made aware of the necessity to specify their objectives in order that maximum efficiency and effectiveness be attained. Generally speaking, most educators can identify some of the more general goals to which they ascribe but fail to bring them down to an operational level. For example, it might be said that the primary goals of public schools are to develop (in students) the power to think clearly, independently, and courageously.[4] Little mention is given to the precise

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3 Cutler, M., "Educational Spending up to $8 Billion". Canadian University and College, Oct., 1969, vol.4, No.10, p.48.

4 Report of the Royal Commission on Education in Ontario, 1950 (The Hall Dennis Commission agreed with these aims)

objectives of various programs and teaching techniques, or as to how these objectives are formulated. It is all but taken for granted that as long as a high percentage of students complete high school, go on to university or good jobs, the schools have been successful. There should be other measures of equal importance within the design of the school's structure which enable administrators to evaluate the institution's effectiveness without complete reliance on the above indicators. Such a method is possible by using a program structure based on a definition of objectives.

Up until the present there have been enough funds to allow the operation of public schools regardless of whether these funds were being used efficiently or not. However, questions are now arising about the possible relevance to educational performance of various changes in educational systems and patterns. What, for instance, would be the benefits of increasing the use of new educational technology in place of a further reduction in student/teacher ratios or the introduction of more flexible curricula as an alternative to the establishment of new programs? To answer such questions requires a better understanding of the learning process itself and a more intensive assessment of the causes of poor resource allocation. According to J. E. Keller[5] these are:

a) the ignorance of, or the overlooking of, a better alternative for accomplishing an objective,

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5 Keller, John: Higher Educational Objectives Measures of Performance and Effectiveness, The University of California, unpublished, April 21, 1969.

b) the pursuit of the wrong objective,

c) the pursuit of the right objective beyond some reasonable point of return,

d) the failure to recognize all the costs involved in an alternative,

e) the failure to consider the long-range implications of present decisions.

There are a number of reasons why people join together to form a group. For example, a number of students may attend an informal gathering to discuss a current political problem. Although certain objectives could arise from such a discussion, (e.g. to take some specific political action), they are not necessarily the primary purpose for the gathering. That is to say, the discussion itself may be the objective of individuals attending the gathering.

Some people would propose the argument that education or more particularly, schools, exist as an end in themselves and, therefore, are not required to declare objectives and to defend programs. This may have been true at some point in history. Today, however, schools increasingly find themselves in a position where they must compete for limited resources in the same arena as post-secondary education, health and welfare programs, transportation, energy production and pollution control, etc.

In other words, the schools today must defend their programs on the basis of goal achievement, i.e. to what degree they fulfill their social, economic or

political purposes. With an increasing percentage of the country's revenue funnelled into the educational process, greater pressure will be brought to bear on public school systems to allocate the scarce resources made available to them to areas of priority within the total system. In a sense, school systems today are paid to define their objectives.

2.2 The Development of Objectives for a School System

2.2.1 The Definition of Objectives

The definition of objectives is an iterative process requiring the re-thinking of issues in light of changing technology, economic conditions and revised social expectations. When new ideas arise, their implications must be evaluated in terms of their compatibility with, or effect on, existing plans and programs.

An objective can be defined as a "quantifiable and/or observable achievement accomplished under specifiable conditions".[6] In the case of a high school, an objective could be e.g. to educate "x" number of students according to set standards so that they may qualify for useful positions in society. From this example we may conclude that there are certain concepts related to an objective.

6 Educational Goals and Objectives. The California School Board Association, September, 1969, P.7

a) There is the idea of directing an existing situation towards a desired end. Energy in the form of monetary funds or human endeavour is spent in various ways to accomplish the objective. In an idealistic situation we could achieve virtually anything with an inexhaustible supply of energy. Since this is not the case we must select the most desired end and the most effective means to that end (or ends).

b) The objectives should suggest ways to measure and control the effectiveness of these alternatives. In the above example, the number of graduates who obtained stated positions would indicate how close the system came to attaining its goal.

c) Objectives can be found at various levels in the organization; primary objectives which assume significance for the whole organization and secondary objectives which support the primary ones but are identified at a precise structural level, e.g. an objective found at the activity level.

2.2.2 Types of Objectives

A school system exists for a multitude of reasons and consequently aspires to a number of different but current goals. In any school system there are two sets of goals--OUTPUT goals and SUPPORT goals.[7]

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[7] The following is an adaptation from Grambsch, P. & Gross, Ed., University Goals and Academic Power, American Council on Education, 1968, p.13-16

a) Output goals are those reflected in some products, service, skill or orientation which affect society. The output goals of a public school system might be expressed as follows:

   1. to teach basic verbal, quantitative and miscellaneous learning skills,

   2. to give students an understanding of their physical environment and the society they live in,

   3. to assist a pupil in the development of practical skills and habits which help to promote a healthy, physical and mental development,

   4. to instill in the pupil a sense of values and an appreciation of the origins and developments of western civilization.

b) Support goals are those which maintain the system and can best be explained by referring to the four elements.

   1. Adaptation goals reflected a need for a school system as an organization to come to terms with the environment in which it is located, e.g., to attract students and staff and to secure needed resources.

   2. Management goals involve decisions on who should run the school system and establish enough priorities as to which output goals

should be given maximum attention, e.g. academic education and/or vocational education.

3. Motivation goals seek to insure high level of satisfaction on the part of the staff and students and emphasize the loyality to the school system as a whole, e.g. to protect the system from outside criticism

4. Position goals help to maintain the position of a school system in terms of some level or hierarchical position it occupies compared with other school systems and in face of trends which could change its position, e.g. maintain a top quality in innovative programs of special importance.

Support goals are mentioned here because it is felt that a good part of any systems' energies must be spent on activities that do not contribute directly to goal attainment but rather are concerned with maintaining the system itself.

3. DEVELOPMENT OF A PROGRAM STRUCTURE

3.1 What is a Program Structure?

A program structure is a hierarchical listing of programs and activities which contribute to the achievement of approved goals and objectives. It indicates the interrelationships between programs and activities, it displays various possible alternatives and it provides the basis for establishing the level at which funding decisions should be made. A program usually consists of several levels. A three leveled program structure seemed appropriate for the York Board of Education.

a) System Programs

A system program represents a major field of involvement of a school system and focuses on its fundamental goals and objectives. The term "system" is used here to indicate that a program, as it is used in the context of a Planning-Programming-Budgeting System, cuts across traditional lines of organization or jurisdictions. Four system programs were identified for the York Board of Education in accordance with the objectives made explicit in the previous section:

1. intellectual and communication skills
2. environmental studies
3. individual development
4. social and cultural development

Each system program consists of a number of subprograms.

b) System Subprograms

A system subprogram consists of a group of interdependent, closely related services or activities contributing to a common objective. A program must be capable of being costed and normally of being evaluated in quantitative terms. Using the above mentioned system programs, various subprograms may be identified, e.g. verbal skills, quantitative skills, physical sciences, vocational training, etc.

c) Activities

Activities are segments of a program that identify homogeneous types of work carried out by the organizational unit which contribute to a program objective. Each activity has an intended end result within the overall objective of a program. Examples of activities are specific sets of classes, seminars or individual consultations.

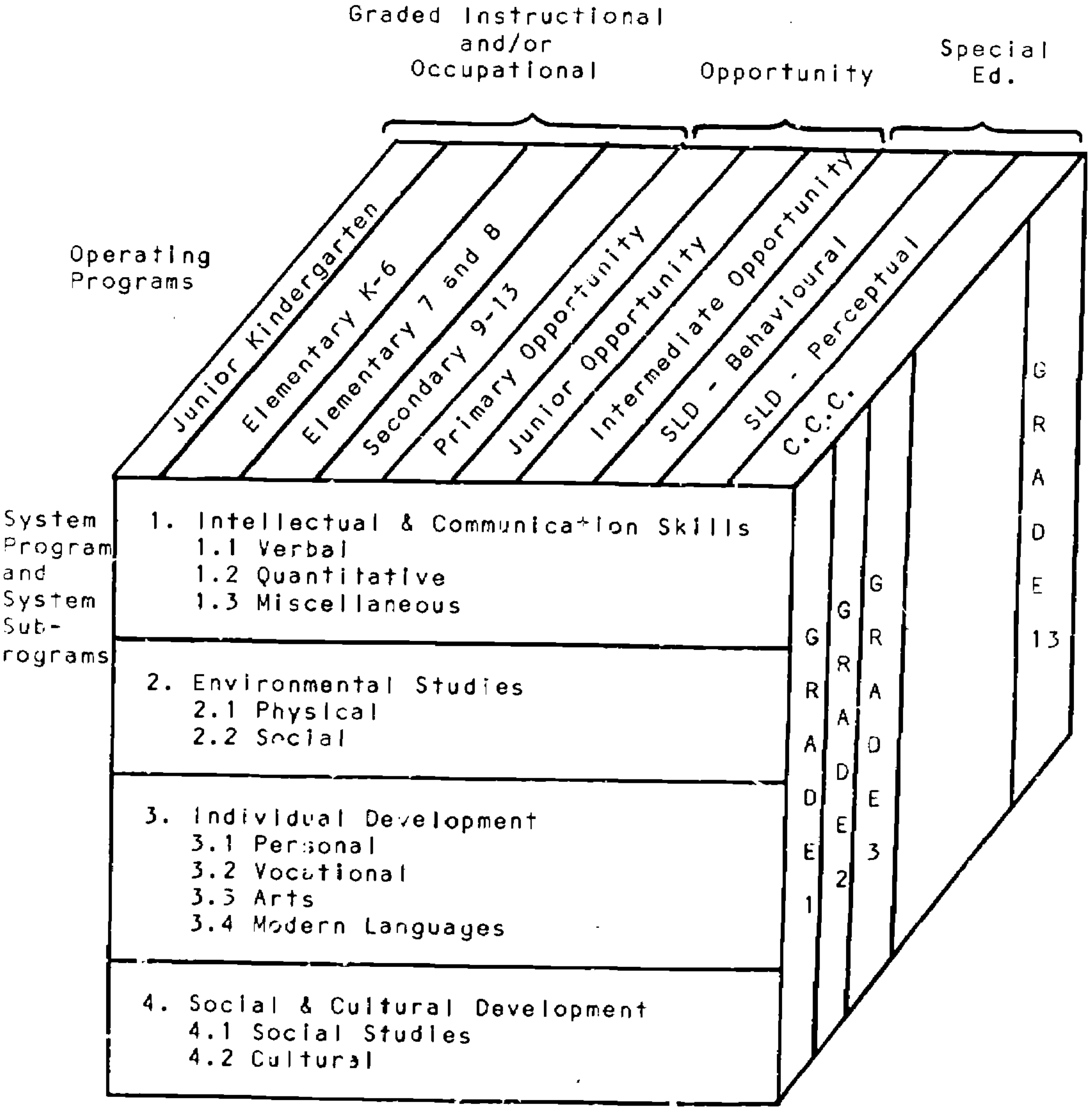
3.2 The Program Structure of the York Board of Education

The type of program structure that has been developed for the York Board of Education and incorporated into the simulation model is graphically represented on Figure 1, which is basically, a three dimensional look at the educational process.

The first dimension, operating programs, represents the organizational structure of the educational process. It begins with junior kindergarten and proceeds to elementary and senior public schools, and then to secondary schools.

Figure 1

PROGRAM STRUCTURE



In addition, a number of special education and opportunity programs have been set up to meet the special needs of a small number of children.

The second dimension consists of the academic achievement level within each of the organizational units. The conventional approach to academic achievement levels, i.e. the thirteen grades, was incorporated. The simulation model has been structured to accept definitions of academic achievement levels other than the traditional grading system.

The third dimension of the program structure that has been developed reflects the implicit objectives of the school system. These objectives were expressed in the previous section. (page 11)

The educational processes of the York Board of Education were analyzed and broken down into approximately 140 distinct activities. Each of the activities were classified according to the system program structure. The following two pages provide a detailed list of system programs, system subprograms and the type of activity that makes up each subprogram.

The system programs were designed to facilitate identification of outputs of the educational process. This is particularly so in terms of the first system program, intellectual and communication skills. This system program might also have been called the "three 'Rs': reading, writing and arithmetic". The Iowa test of Basic Skills, among others, could be used to measure in an objective quantitative manner, the achievement of children, individually or collectively, or the growth in achievement.

SYSTEM PROGRAM STRUCTURE

SYSTEM PROGRAM
SYSTEM SUB-PROGRAM
ACTIVITIES

1. INTELLECTUAL AND COMMUNICATION SKILLS

1.1 Verbal Skills

- English Composition, Basic English, Opportunity, Effective Reading Remedial Reading,

1.2 Quantitative Skills
- Mathematics, Math A, Math B, Computer Science,

1.3 Miscellaneous Skills

- Library, Individual Instruction, Activity, Audio-Visual, Remedial Work.

2. ENVIRONMENTAL STUDIES

2.1 Physical Sciences

- Geography, Science, Biology, Physics, Chemistry, Geology,

2.2 Social Sciences

- Environmental Studies, Man in Society, Social Science, Economics,

3. INDIVIDUAL DEVELOPMENT

3.1 Personal Development
- Physical Education, Health, Guidance, Recess, Games, Primary Opportunity Classes, Junior Opportunity Class, Canadian Citizenship Education, S.L.D. Classes,

SYSTEM PROGRAM STRUCTURE (Cont'd)

3.2 Vocational Development

- Home Economics, Industrial and Applied Crafts, Intermediate Opportunity Classes, Data Processing, Commercial, Typing, Bookkeeping, Record-keeping, Shorthand, Office Practice, Business Correspondence, Business Organization and Management, Business Maths, Maths and Machines, Business Law, Business Finance, Marketing, Technology, Shop-work, Business Practice,

3.3 Arts

- Speech and Drama, Film, Music, Art, Theatre Arts,

3.4 Modern Languages

- French, German, Italian,

4. SOCIAL AND CULTURAL DEVELOPMENT

4.1 Social Studies

- History, Current Events, Social Studies, World Politics,

4.2 Cultural Activities

- English Literature, Opening Exercises, Greek, Latin, Mass Media, Kindergarten, Junior Kindergarten,

Analysis of the kind where the cost of system programs at individual schools may be directly related to the outputs of those programs, may form the basis on which judgements may be made about the relative efficiency and effectiveness of various schools within a system or of various systems.

4. ANALYTICIAL CAPABILITIES OF THE CONNECT/CLASS MODEL

The basic objective of the CONNECT/CLASS simulation model is to provide the York Board of Education with the capability to ask "what if" questions. The data that has been collected from the York Board of Education on staff, space, students, program, finance,etc. represents in as much as this was possible, the actual operations of the York Board of Education during the 1969 - 1970 school year. In addition, enrollment projections were made for the next four years.

The simulation model provides the ability to change any one of the variables in the data base to determine the effect of the change on resource requirements in terms of staff, space, equipment and other resources at an individual cost centre, school or the York Board as a whole.

It should be pointed out that not each variable in the model is really sensitive. In other words, certain variables within the model may be changed without affecting any resource requirements. Most of these variables, as can be seen on Table 1, are the various names given to cost centres, programs, resource types and sub-types,etc. Table 2, however, provides a list of those variables which do affect the outcome of the simulation. Thus, typically, an experiment will consist of a change in one or a combination of several variables. In addition to the splitting up of the variables into sensitive and non-sensitive variables, the variables may further be classified according to whether they are system variables,i.e. they affect the entire Board of Education, or school variables, i.e. specific to an individual school. It must be remembered that by listing the variables, only the types of changes are represented. For example, the minutes per week that an activity takes place in a particular grade at a particular school may vary from school to school. In an experimental situation, the duration of the particular

TABLE 1

NON SENSITIVE VARIABLES
(Variables which do not affect the outcome of simulations)

AREA	SYSTEM VARIABLE	SCHOOL VARIABLE
STRUCTURAL DEFINITIONS	- School Board Name - First Calendar Year - Case Description	
	- School Type Name	
		- School Name
	- Cost Centre Type Name - Cost Centre Name	
	- Operating Program - Type of Name - Operating Program Name	
	- Functional Basis Name	
	- Resource Category Name - Resource Type Name - Resource Subtype Name	
ACTIVITIES	- Activity Type Name - System Sub-Program Name - System Program Name	
STAFF	- Teaching Staff - Function Name - Salary Ranges Name	

activity could be changed for one particular grade at one school or for any number of grades or for any number of schools. In the same way, transition rates for students apply to each grade of each program of each school. This in effect means that the data base contains several hundred different transition rates, each of which applies to one particular situation. This means that each of the transition rates could be changed individually or all transition rates could be changed collectively.

Following the listing of sensitive and non-sensitive variables, is a section which describes the problems that can and cannot be analysed with the simulation model in general, and more specifically in the areas of finance, space planning, enrollment, program planning, teaching methods and staff planning.

TABLE 2

SENSITIVE VARIABLES

(Variables which do affect the outcome of simulations)

AREA	SYSTEM VARIABLES	SCHOOL VARIABLES
STRUCTURAL DEFINITIONS	- Number of Sessions to be simulated - Number of simulation periods per session - Length of simulation periods in weeks - Hours per week - Hiring Policy	
		- School Type
	- Cost Center Type - Cost Center Level - Cost Center of Aggregation	- Cost Center Type
	- Board Cost Centers	- School Cost Centers

	- Operating Program
	  - Program Type
	  - Number of grades
	  - Starting Grade	

		- School Operating Programs - last grade in program

	- Resource Subtype
	  - Resource Type
	  - Resource Category	

ACTIVITIES	- Section Size Codes
	  - Minimum
	  - Desired
	  - Maximum	

	- Resource Combination Codes
	  - Resource Type & Subtype
	  - Functional Basis
	  - Quantity	

	- Activity
	  - Activity Type
	  - System Sub-Program
	  - Section Size
	  - Resource Combination Code	

TABLE 2 (cont'd)

SENSITIVE VARIABLES (CONT'D)

AREA	SYSTEM VARIABLES	SCHOOL VARIABLES
PROGRAM	- System Program Structure	- Activity - Cost Center Ownership - Participation Rate - Minutes per week - Program - Grade - Activity Combination
ENROLLMENT		- Program - Grade - Transition - School - Program - Grade - Percentage
STAFF	- Teaching Staff Type - Salary Range - destination - salary range - percentage - New Staff - Salary Range - Percentage - Aug. Salary	- Teaching Staff Type - Function - Staffing Units - Teaching Staff Type - Salary Range - Inventory - Aug. Salary

TABLE 2 (cont'd)

SENSITIVE VARIABLES (CONT'D)

AREA	SYSTEM VARIABLES	SCHOOL VARIABLES
SPACE	- Space Type - Cost Center - Basis - Quantity	- Teaching Space Type - Size - Quantity
	- Space Type - Subtype - Cost Code	- Non-Teaching Space - Subtype - Functional basis - Quantity
		- Teaching Space Type - Subtype - Utilization
NON-TEACHING STAFF	- Non-Teaching Staff - Subtype - Average Salary - Conversion Units	
EQUIPMENT	- Equipment - Subtype - Average Cost - Conversion Units	
OTHER RESOURCES	- Other resources -Subtype - Average Cost - Conversion Units	- Indirect Resources - Subtype - Functional basis - Quantity
	- Indirect Resources - Subtype - Functional basis - Quantity - Cost Center	

5. THE PROBLEMS OF THE YORK BOARD OF EDUCATION THAT CAN AND CANNOT BE ANALYSED WITH THE CONNECT/CLASS SIMULATION MODEL.

5.1 IN GENERAL

The simulation model cannot:

- forecast exogenous inputs, for example, data on enrollment or rules on staff workloads
- predict community needs
- evaluate the quality of education
- create alternatives, but does analyse them in economic terms.

The simulation model can:

- calculate the resource requirements of alternative educational programs
- compare the cost of different administrative rules and staff, space, equipment, enrollment
- enable school principals and Board of Education officials to manage and plan more effectively

5.2 FINANCE

The simulation model cannot:

- predict operating and capital allocations from metro except where such allocations are governed by specific formulas
- control expenditures or serve as a cost accounting system except in a summary way

The simulation model can:

- provide detailed cost estimates for individual schools, programs within individual schools, individual activities within schools or, in an aggregate way, total cost of all schools, all departments, total program costs and costs for the Board offices.

- be used on different assumed funding levels to indicate what activities, programs, enrollments and teaching methods can be supported.
- be the analytical mechanism of a Planning - Programing - Budgeting system.
- facilitate preparation of annual budgets and long-term growth plans for review by senior authorities.
- provide detailed justification of requests for operating and capital funds.

5.3 PHYSICAL FACILITIES

The simulation model cannot:

- say what kind of space should be used in a given program, or set class size.
- prescribe certain sizes of offices,etc. for teaching and non-teaching staff.
- lay down policies on ancilliary facilities such as libraries, cafeterias, etc.

The simulation model can:

- forecast detailed requirements for instructional, administrative and ancilliary space under alternative situations.
- assess the impact on the need for various types of classrooms and laboratories of changes in teaching methods, enrollment, etc.
- pinpoint overages, shortages and per cent utilization of different kinds of space at different future times.
- assess the economics of a phased construction program.
- evaluate the effect, on space needs, of changes in the length of the teaching week, computerized scheduling, duration of the school year, etc.
- assess the economics of modular building systems and moveable partitions.

- produce information for architects regarding the needs of a particular school.

5.4 ENROLLMENT

The simulation cannot:

- predict enrollment.
- predict student choices of courses in high school.
- tell about community needs.
- forecast success of students.

The simulation model can:

- calculate resources needed for different enrollments.
- indicate future enrollment on the basis of information regarding transition rates and new entrants into the system.
- assess different mixes of programs.
- help cope with uncertainty and variations in actual enrollment.
- evaluate the economies of scale.
- help set timing of acquisition of new resources.

5.5 PROGRAM PLANNING

The simulation model cannot:

- decide what programs and activities should be offered.
- balance academic versus vocational subjects.
- determine the need of the community.
- design curriculum content.

The simulation model can:

- compare the resources (staff, space, equipment, etc.) needed for different mixes of programs.
- analyse the resource requirements for changes in the program.
- compare cost of educating students in regular schools, inner-city schools, special programs.

5.6 TEACHING METHODS

The simulation model cannot:

- say which methods are pedagogically best.
- generate new teaching ideas.
- evaluate progress of students.

The simulation model can:

- help make trade-off analyses of different teaching methods.
- highlight the cost of introducing new methods.
- calculate how education costs will rise with enrollment given possible changes in teaching methods, e. g. changes in class size, team teaching, open concept teaching, individualized instruction.
- help tie together enrollment, program decisions and available resources into a coherent plan.

5.7 STAFF PLANNING

The simulation model cannot:

- say what kinds of staff should be hired.
- help recruit staff directly.
- evaluate teacher performance.
- determine staffing policy.

The simulation model can:

- calculate the requirements of various staff.
- take into account alternative staffing policies, such as work-load, hiring practices,etc.
- analyse the costs of different mixes of staff.
- predict future staff work requirements under alternative educational and administrative policies.
- calculate future operating costs on a different staffing policy and salary scales.

6. DESCRIPTION OF THE BASE CASE SIMULATION

Figure I presents the results of a five-year simulation in which all policies were held constant. The only input which varied for each year was enrollment information.

The report indicates that from an initial enrollment of 23,763 in 1969 - 1970, the enrollment is expected to grow to 24,792 in 1970 - 1971 and up to 27,274 in 1973 - 1974. The enrollment projection is based on the following information:

1. For 1969 - 1970 actual enrollment figures for each grade of each program at each school were fed in directly.

2. For 1970 - 1971, enrollment again was fed in directly. The information was based on the best possible projection that had been arrived at jointly by the York Board of Education and the Metropolitan School Board.

3. Enrollment for the next three years was calculated by applying transition rates to the 1970 - 1971 enrollment. In addition, new entrants to the York Board of Education were specified on the basis of the best possible information available from the Borough of York on probable future apartment developments. Furthermore, the assumption was made that the number of students coming from the separate schools to the high schools of the York Board of Education would remain constant for the next three years.

The simulation showed that on the basis of the enrollment pattern, described above, the total expenditures for the York Board of Education would increase from approximately $18.6 million in

FIGURE 1

YORK BOROUGH BOARD OF EDUCATION
SUMMARY REPORT
****

		1969-70	1970-71	1971-72	1972-73	1973-74
ENROLMENT (NO.)						
1	ELEMENTARY K - 6	12445	12819	13172	13951	13976
2	ELEMENTARY 7 + 8	3121	3109	3472	3705	3886
3	JR. KINDERGARTEN	486	1003	1026	1026	1026
4	SECONDARY 9 - 13	6694	6822	6710	7081	7136
5	PRIMARY OPPORTUNITY	66	66	60	60	60
6	JUNIOR OPPORTUNITY	83	115	80	80	80
7	INT. OPPORTUNITY	81	50	32	48	48
8	SLD - BEHAVIOUR	20	15	8	8	8
9	SLD - PERCEPTUAL	7	0	40	48	48
10	CANADIAN C.C.	38	65	65	55	65
11	OCCUPATIONAL	462	474	538	614	678
12	SPEC. VOCATIONAL	260	254	257	260	263
	TOTAL	23763	24792	25460	26946	27274
STAFF (NO.)						
	TEACHING	1083	1130	1154	1200	1222
	NON-TEACHING	506	521	530	548	556
SPACE						
	INSTRUCTIONAL (ROOMS)	920	953	978	1015	1032
	ADMINISTRATIVE (SQ. FT)	182573	189[illegible]	194045	203621	206529
	SERVICE	0	0	0	0	0
	BOARD OFFICES	0	0	0	0	0
EXPENDITURES ($)						
	TEACHING STAFF	10731123	11187943	11439267	11881583	12079484
	NON-TEACHING STAFF	3346301	3436239	3490726	3632316	3670197
	EQUIPMENT	0	0	0	0	0
	OTHER	4540786	4622712	4653160	4723582	4746823
	TOTAL	18620210	19246894	19583153	20237481	20496504

1969 - 1970 to approximately $20.5 million in 1973 - 1974. This increase in cost is due directly to the increasing work load placed on the York Board of Education. It does not reflect any probable increases in wages in prices. In other words, the cost figures for each of the five years are in 1969 constant dollars, (later on in this document the effects of an average annual salary increase of 8% will be demonstrated).

The number of teachers required to teach the increasing number of students would rise from 1,083 in 1969 - 1970 to 1,222 in 1973 - 1974. It must be noted that this figure excludes the French teachers at elementary schools. The number of teachers required is based on the assumption that present staffing policies would remain constant. Further on in this document, the fact of a 10% decrease in teaching staff workload will be demonstrated.

As the enrollment, expenditures and number of teachers required increases, so also does the number of instructional rooms increase. The simulation shows that in the next five years the York Board of Education would probably have to build an additional 112 rooms to accommodate the expected increase in enrollment. Later on in this document, it will be shown at what particular schools the increase in room requirements takes place.

Figure II gives a further insight into the overall results of the Base Case Simulation. At present the model is programmed to calculate student/teacher, student/total staff, and cost/student. Of course it is possible to calculate any number of additional indicators. As the development on the model continues, additional indicators such as average class size, total square feet per student at a school, cost per student in particular grades of programmes, etc. will be incorporated.

FIGURE 2.

YORK BOROUGH BOARD OF EDUCATION
SUMMARY REPORT
****

INDICATORS	1969-70	1970-71	1971-72	1972-73	1973-74
STUDENT / TEACH					
JUNIOR SCHOOL	26	25	25	26	26
SENIOR SCHOOL	20	20	23	23	24
COMPOSITE SCHOOL	27	27	27	27	27
INNER-CITY JR.	27	28	28	28	28
INNER-CITY SR.	20	20	21	23	24
INNER-CITY COMP.	0	0	0	0	0
SECONDARY SCHOOL	17	17	16	16	16
OPPORTUNITY	13	12	12	13	13
OCCUPATIONAL	11	12	12	12	12
STUDENT / TOT SF					
JUNIOR SCHOOL	18	18	18	19	19
SENIOR SCHOOL	15	15	17	17	18
COMPOSITE SCHOOL	20	19	19	20	19
INNER-CITY JR.	19	20	20	20	20
INNER-CITY SR.	16	16	16	18	18
INNER-CITY COMP.	0	0	0	0	0
SECONDARY SCHOOL	12	12	12	12	12
OPPORTUNITY	9	9	9	9	9
OCCUPATIONAL	9	9	9	9	9
AVERAGE CLASS SZ					
JUNIOR SCHOOL	0	0	0	0	0
SENIOR SCHOOL	0	0	0	0	0
COMPOSITE SCHOOL	0	0	0	0	0
INNER-CITY JR.	0	0	0	0	0
INNER-CITY SR.	0	0	0	0	0
INNER-CITY COMP.	0	0	0	0	0
SECONDARY SCHOOL	0	0	0	0	0
OPPORTUNITY	0	0	0	0	0
OCCUPATIONAL	0	0	0	0	0
COST / STUDENT					
JUNIOR SCHOOL	519	508	505	491	493
SENIOR SCHOOL	673	667	590	579	566
COMPOSITE SCHOOL	470	507	511	504	509
INNER-CITY JR.	501	481	481	474	471
INNER-CITY SR.	604	601	583	536	519
INNER-CITY COMP.	0	0	0	0	0
SECONDARY SCHOOL	937	923	947	934	947
OPPORTUNITY	1320	1347	1334	1320	1307
OCCUPATIONAL	1311	1282	1236	1198	1157

6.1 ENROLLMENT PROJECTION

Since the number of students is, of course, one of the most important variables in the simulation model, it is important to understand how the enrollment figures were arrived at.

Figures 3 A and 3 B show the number of students enrolled in each grade of each programme of the York Board of Education. For the years 1969 - 1970 and 1970 - 1971 this information was a direct input for each school. Figure 4 shows the input document or coding sheet on which the enrollment information for York Memorial Secondary School is entered. School code 32 is used to identify York Memorial. The operating programme is 4, Secondary 9 - 13. The same form was used to input the enrollment information for each elementary and secondary school within the York Board of Education for 1969 - 1970 and 1970 - 1971.

Figure 5 shows the distribution of new students for several secondary schools within the system. This report represents the actual number of students enrolled at the various schools during the 1969 - 1970 session.

Enrollment figures for subsequent years may be worked out in one of two ways. First of all, the enrollment information may once again be fed in directly in the way that was shown for 1969 - 1970 or, secondly, transition rates may be applied to arrive at the new enrollment figures. Figure 6 shows the transition rates that are being used for York Memorial Secondary School and some other high schools. It indicates that 92% of grade 9 students are expected to go on to grade 10. 8% of the students are expected to either drop out of the system or transfer to another school outside of the York Board of Education. 94% of grade 10 students are expected to go on to grade 11.

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FIGURE 3 A

YORK BOROUGH BOARD OF EDUCATION
SUMMARY ENROLMENT REPORT

OPERATING PROGRAM NAME	GRADE	NUMBER OF STUDENTS 1969-70	1970-71	1971-72	1972-73	1973-74
ELEMENTARY K - 6	K	1893	1949	2025	2087	2087
	1	2004	2064	1933	2086	2051
	2	1841	1901	2046	1992	2049
	3	1800	1853	1886	2103	1954
	4	1749	1801	1837	1945	2065
	5	1621	1674	1785	1895	1910
	6	1537	1577	1660	1843	1860
OPERATING PROGRAM TOTAL		12445	12819	13172	13951	13976
ELEMENTARY 7 + 8	7	1591	1571	1567	1725	1809
	8	1530	1538	1905	1980	2077
OPERATING PROGRAM TOTAL		3121	3109	3472	3705	3886
JR. KINDERGARTEN	J	486	1003	1026	1026	1026
OPERATING PROGRAM TOTAL		486	1003	1026	1026	1026
SECONDARY 9 - 13	9	1747	1775	1668	2054	2061
	10	1726	1753	1558	1498	1796
	11	1444	1469	1548	1416	1322
	12	1205	1230	1313	1420	1260
	13	572	595	623	693	697
OPERATING PROGRAM TOTAL		6694	6822	6710	7081	7136
PRIMARY OPPORT:Y	N	66	66	60	60	60
OPERATING PROGRAM TOTAL		66	66	60	60	60
JUNIOR OPPORT:Y	N	63	115	80	80	80
OPERATING PROGRAM TOTAL		63	115	80	80	80
INT. OPPORTUNITY	N	81	50	32	48	48

YORK BOROUGH BOARD OF EDUCATION
SUMMARY ENROLMENT REPORT

OPERATING PROGRAM NAME	GRADE	NUMBER OF STUDENTS 1969-70	1970-71	1971-72	1972-73	1973-74
OPERATING PROGRAM TOTAL		81	50	32	48	48
SLD - BEHAVIOUR	N	20	15	8	8	8
OPERATING PROGRAM TOTAL		20	15	8	8	8
SLD - PERCEPTUAL	N	7	0	40	48	48
OPERATING PROGRAM TOTAL		7	0	40	48	48
CANADIAN C.C.	N	38	65	65	65	65
OPERATING PROGRAM TOTAL		38	65	65	65	65
OCCUPATIONAL	9	252	258	301	344	371
	10	210	216	237	270	307
OPERATING PROGRAM TOTAL		462	474	538	614	678
SPEC. VOCATIONAL	7	130	132	135	138	141
	8	130	122	122	122	122
OPERATING PROGRAM TOTAL		260	254	257	260	263

FIGURE 3B

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FIGURE 4

Command Level

1	2	3	4	5	6	7	8	9	10
S	T	U	D	E	N	T		0	1

Lines/Card: 1
Cards/Sheet: 14

INPUT DOCUMENT

Sheet ____ of ____

Date ____________

Coder ____________

ENR...NT OF NEW STUDENTS IN SCHOOLS

School Code (11-13)	"S.A." Flag (14)	"SAME AS" Code (15-17)	Op. Prog. (18-19)	Associated Gr. (20-22)	New Ents. (23-27)	Op. Prog. (28-29)	Associated Gr. (30-32)	New Ents. (33-37)	Op. Prog. (38-39)	Associated Gr. (40-42)	New Ents. (43-47)	Op. Prog. (48-49)	Associated Gr. (50-52)	New Ents. (53-57)	Op. Prog. (58-59)	Associated Gr. (60-62)	New Ents. (63-67)
32				4 9	216		4 1 2	242		4 1 1	191		4 1 2	184		4 1 3	102

Explanation: 1. "SAME AS" Flag: 1 - yes
2 - no

FIGURE 5

DISTRIBUTION OF NEW STUDENTS INTO OPERATING PROGRAMS

SCHOOL CODE	SCHOOL NAME	OPERATING PROGRAM CODE	OPERATING PROGRAM NAME	GRADE	NUMBER OF NEW STUDENTS
29	RUNNYMEDE	4	SECONDARY 9 - 13	12	230
				13	156
30	VAUGHAN ROAD	4	SECONDARY 9 - 13	9	390
				10	331
				11	323
				12	210
				13	134
31	WESTON	4	SECONDARY 9 - 13	9	263
				10	285
				11	278
				12	245
				13	114
32	YORK MEMORIAL	4	SECONDARY 9 - 13	9	216
				10	242
				11	191
				12	184
				13	102
33	FRANK OKE	12	SPEC. VOCATIONAL	7	130
				8	130
34	YORK HUMBER	11	OCCUPATIONAL	9	252
				10	210
35	ARLINGTON SR.	2	ELEMENTARY 7 + 8	7	0
				8	0
		7	INT. OPPORTUNITY	M	0
		9	SLD - PERCEPTUAL	M	0

STUDENT TRANSITION INFORMATION
****

SCHOOL CODE	SCHOOL NAME	OPERATIONAL PROGRAM CODE	OPERATIONAL PROGRAM NAME	GRADE	DESTINATION SCHOOL CODE	DESTINATION SCHOOL NAME	DESTINATION OP. PROGRAM CODE	DESTINATION OP. PROGRAM NAME	GRADE	TRANSITION RATE
31	WESTON	4	SECONDARY 9 - 13	9	31	WESTON	4	SECONDARY 9 - 13	10	84
					31	WESTON		ATTRITION		16
				10	31	WESTON	4	SECONDARY 9 - 13	11	87
					31	WESTON		ATTRITION		13
				11	31	WESTON	4	SECONDARY 9 - 13	12	88
					31	WESTON		ATTRITION		12
				12	31	WESTON	4	SECONDARY 9 - 13	13	44
					31	WESTON		GRADUATE		56
				13	31	WESTON	4	SECONDARY 9 - 13	13	5
					31	WESTON		GRADUATE		90
					31	WESTON		ATTRITION		5
32	YORK MEMORIAL	4	SECONDARY 9 - 13	9	32	YORK MEMORIAL	4	SECONDARY 9 - 13	10	92
					32	YORK MEMORIAL		ATTRITION		8
				10	32	YORK MEMORIAL	4	SECONDARY 9 - 13	11	94
					32	YORK MEMORIAL		ATTRITION		6
				11	32	YORK MEMORIAL	4	SECONDARY 9 - 13	12	86
					32	YORK MEMORIAL		ATTRITION		14
				12	32	YORK MEMORIAL	4	SECONDARY 9 - 13	13	74
					32	YORK MEMORIAL		GRADUATE		26
32	YORK MEMORIAL	4	SECONDARY 9 - 13	13	32	YORK MEMORIAL		GRADUATE		86
					32	YORK MEMORIAL	4	SECONDARY 9 - 13	13	7
					32	YORK MEMORIAL		ATTRITION		7
33	FRANK OKE	12	SPEC. VOCATIONAL	7	33	FRANK OKE	12	SPEC. VOCATIONAL	7	100
				8	33	FRANK OKE	12	SPEC. VOCATIONAL	8	100
34	YORK HUMBER	11	OCCUPATIONAL	9	34	YORK HUMBER	11	OCCUPATIONAL	9	50
					34	YORK HUMBER	11	OCCUPATIONAL	10	50
				10	34	YORK HUMBER	11	OCCUPATIONAL	10	50
					34	YORK HUMBER		ATTRITION		50
35	ARLINGTON SR.	2	ELEMENTARY 7 + 8	7	35	ARLINGTON SR.	2	ELEMENTARY 7 + 8	8	98
					35	ARLINGTON SR.		ATTRITION		2
					35	ARLINGTON SR.	2	ELEMENTARY 7 + 8	8	98
					35	ARLINGTON SR.		ATTRITION		2
				8	30	VAUGHAN ROAD	4	SECONDARY 9 - 13	9	78
					28	GEORGE HARVEY	4	SECONDARY 9 - 13	9	17
					34	YORK HUMBER	11	OCCUPATIONAL	9	5
		7	INT. OPPORTUNITY	N	35	ARLINGTON SR.		ATTRITION		100
		9	SLC - PERCEPTUAL	[illegible]	35	ARLINGTON SR.		ATTRITION		100

FIGURE 6

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6% of grade 10 students are expected to either drop out of the system of transfer to another school outside of the system. In grade 12 and grade 13 the number of possibilities increases. For example in grade 13 86% of the students are expected to graduate, 7% are expected to repeat the year and, 7% are expected to drop out of school or transfer to a school outside of the York Board of Education.

It is important to realize that the simulation model does not calculate enrollment as such. It acts strictly on the assumptions concerning enrollment that are input. In doing so, it provides the user of the model with a unique capability of experimentation with varying enrollments. Different enrollment assumptions may be input in order to determine the impact of varying enrollment patterns on resource requirements at individual schools or at the board in its entirety.

6.2 CALCULATION OF RESOURCE REQUIREMENTS

Central to the calculation of resource requirements is the concept of the activity. Students enrolled in a particular grade of a particular programme at a school participate in various activities which require resources. The most frequent resource requirements of activities consist of a teacher and a classroom of some particular type. A total of 140 different activities were identified in the York Board of Education. Each activity was given certain descriptions. First of all the type of the activity was specified, e.g. classroom, laboratory, field trip, etc. Secondly, each activity was classified into a system programme and sub-programme. Thirdly, the desired class size for any particular activity was specified. Fourthly, the resources required for each activity were specified.

Figure 7 indicates the activities which were offered by York

YORK BOROUGH BOARD OF EDUCATION
SESSION 1969-70

INPUT DATA REPORTS 3.1
SOURCE DOCUMENTS PROGRAM 01
PROGRAM 02
PROGRAM 03

FIGURE 7

OPERATING PROGRAMS
YORK MEMORIAL
****

OP. PROGRAM CODE	OP. PROGRAM NAME	GRADE	ACTIVITY COMBINATION CODE	ACTIVITY COMBINATION NAME	ACTIVITY CODE	ACTIVITY NAME	COST CENTER CODE	COST CENTER NAME	PARTIC. RATE	MINUTES PER WEEK
4	SECONDARY 9 - 13	9	195		50	ENGLISH COMP.	2	ENGLISH DEPT.	100 (	80
					51	ENGLISH LITERAT.	2	ENGLISH DEPT.	100 (	120
					52	LIBRARY	2	ENGLISH DEPT.	100 (	33
					78	PHYSICAL EDUC'N	9	P.E. DEPT	100 (	33
					61	HISTORY	3	HIST + EC DEPT	100 (	200
					67	SCIENCE	6	SCIENCE DEPT.	100 (	200
					56	FRENCH	4	MODERNS DEPT.	100 (	167
					75	ART	18	ART DEPT.	50 (	167
					83	TYPING	17	LIBRARY DEPT.	100 (	167
					77	GUIDANCE	8	GUIDANCE DEPT.	100 (	200
					72	MATHEMATICS	5	MATH DEPT.	100 (	200
					53	EFFECTIVE READIG	2	ENGLISH DEPT.	100 (	67
					76	MUSIC - INSTR.	19	MUSIC DEPT.	50 (	167
		10	196		50	ENGLISH COMP.	2	ENGLISH DEPT.	100 (	80
					51	ENGLISH LITERAT.	2	ENGLISH DEPT.	100 (	120
					78	PHYSICAL EDUC'N	9	P.E. DEPT	100 (	200
					66	GEOGRAPHY	16	GEOGRAPHY DEPT.	100 (	200
					67	SCIENCE	6	SCIENCE DEPT.	96 (	200
					60	LATIN	10	CLASSICS DEPT	26 (	200
					56	FRENCH	4	MODERNS DEPT.	91 (	200
					75	ART	18	ART DEPT.	27 (	200
					83	TYPING	17	LIBRARY DEPT.	55 (	200
					77	GUIDANCE	8	GUIDANCE DEPT.	100 (	200
					72	MATHEMATICS	5	MATH DEPT.	95 (	200
					55	THEATRE ARTS	2	ENGLISH DEPT.	12 (	200
					76	MUSIC - INSTR.	19	MUSIC DEPT.	28 (	200
		11	197		50	ENGLISH COMP.	2	ENGLISH DEPT.	100 (	80
					51	ENGLISH LITERAT.	2	ENGLISH DEPT.	100 (	120
					78	PHYSICAL EDUC'N	9	P.E. DEPT	100 (	200
					61	HISTORY	3	HIST + EC DEPT	45 (	200
					66	GEOGRAPHY	16	GEOGRAPHY DEPT.	83 (	200
					68	BIOLOGY	6	SCIENCE DEPT.	19 (	200
					69	PHYSICS	6	SCIENCE DEPT.	80 (	200
					60	LATIN	10	CLASSICS DEPT	13 (	200
					56	FRENCH	4	MODERNS DEPT.	91 (	200
					57	GERMAN	4	MODERNS DEPT.	17 (	200
					75	ART	18	ART DEPT.	13 (	200
					84	BOOKKEEPING	17	LIBRARY DEPT.	12 (	200

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Memorial Secondary School in Grades 9, 10 and 11 during the 1969 - 1970 school year. For example, the first activity in grade 9 is activity 50 English Composition. English Composition is offered by the English department at York Memorial. The report specifies that 100 percent of the grade 9 students at York Memorial take English Composition for 80 minutes per week.

Figure 4 showed that the 1969 - 1970 enrollment at York Memorial in grade 9 was 216. We also know that the maximum class size of English Composition is 30 students per class. This means that seven separate sections have to be set up to teach English Composition at York Memorial. The resources required to teach English have been defined as consisting of one teacher per section and one classroom per section. Since there are seven sections which take place for 80 minutes per week, we now know that in order to teach English Composition at York Memorial we need 560 minutes per week of a teacher and a standard type classroom. Similarly, York Memorial requires 840 minutes per week or 14 hours, to teach English literature. Thus, to teach, both English Composition and Literature at York Memorial requires 23 hours of a teacher and a classroom.

6.3 CONTACT HOUR CONVERSION OF STAFF AND SPACE

Once the simulation model has calculated the total contact hours required for each type of resource that has been specified as being required for any particular activity, the model then proceeds to convert the contact hours to the number of full time teachers required and classrooms required.

Figure 8 contains basic information concerning staff policies. It indicates, for example, that teachers at York Memorial are expected to teach on an average 18 hours per week, to supervise extra-curricular activities for 5 hours a week and to devote 10 hours a week to curriculum planning.

FIGURE 8

INPUT DATA REPORTS 5.2
SOURCE DOCUMENTS& STAFF 02
PAGE 10

SCHOOL TEACHING STAFF PROFILES

SCHOOL NUMBER	SCHOOL NAME	TEACHING STAFF CODE	TEACHING STAFF NAME	FUNCTION CODE	PROFILE FUNCTION NAME	STAFFING UNITS
30	VAUGHAN ROAD	5	FRENCH			
31	WESTON	1	PRINCIPL	2	ADMIN.	35.00
		2	VICE-PR	2	ADMIN.	30.00
				3	SUPERVIS	5.00
		3	TEACHER	1	TEACHING	18.00
				3	SUPERVIS	5.00
				4	PLANNING	10.00
		4	DEPT HD	1	TEACHING	8.00
				2	ADMIN.	15.00
				3	SUPERVIS	5.00
				4	PLANNING	5.00
		5	FRENCH			
32	YORK MEMORIAL	1	PRINCIPL	2	ADMIN.	35.00
		2	VICE-PR	2	ADMIN.	30.00
				3	SUPERVIS	5.00
		3	TEACHER	1	TEACHING	18.00
				3	SUPERVIS	5.00
				4	PLANNING	10.00
		4	DEPT HD	1	TEACHING	8.00
				2	ADMIN.	15.00
				3	SUPERVIS	5.00
				4	PLANNING	5.00
		5	FRENCH			
33	FRANK OKE	1	PRINCIPL	2	ADMIN.	35.00
		2	VICE-PR	1	TEACHING	10.00
				2	ADMIN.	15.00
				3	SUPERVIS	5.00
		3	TEACHER	1	TEACHING	28.00
				3	SUPERVIS	2.00
				4	PLANNING	3.00
		4	DEPT HD			
		5	FRENCH	1	TEACHING	28.00
				3	SUPERVIS	2.00
				4	PLANNING	3.00

NOTE:

It should be understood that the staffing units specified on Input Data Report 5.2 are used only to demonstrate the concept and do not in any way represent the official policy of the York Board of Education.

To continue with the example started in a previous section, York Memorial would require more than one teacher to teach the 23 scheduled hours of English Literature and Composition. In this way the total contact hour requirements of various types of resources such as teachers, classrooms and laboratories are calculated for the entire school. In addition, the model specifies that each school has a principal who is not available for regularly scheduled teaching, a vice-principal who is available for teaching only part of the time and various department heads whose teaching load has been reduced in order to allow them to look after various administrative duties.

In order to arrive at the number of classrooms and laboratories required, the number of contact hours required is divided by the number of hours that a classroom will be available during a normal teaching week. The availability of instructional space is based on two variables:

- the number of hours in a teaching week
- the maximum utilization rate for each particular type of space

For example, the user of the model may specify that the length of the teaching week is 30 hours. This basically means that classes are scheduled over a period not exceeding six hours per day. If the maximum utilization rate is determined to be 80% then the particular classroom or laboratory would in fact only be available, in terms of the model, for 24 hours per week. In other words that for each 24 hours that a classroom is asked for, the model would specify that one complete classroom would be required.

6.4 THE MATCHING OF RESOURCE REQUIREMENTS WITH AVAILABLE RESOURCES

Part of the input to the model consists of the number of principals, vice-principals, teachers, department heads, etc. which

FIGURE 9

SCHOOL TEACHING STAFF AND AVERAGE SALARIES

SCHOOL CODE	SCHOOL NAME	STAFF TYPE CODE	STAFF TYPE NAME	STAFF SUBTYPE CODE	STAFF SUBTYPE NAME	SALARY RANGE CODE	SALARY RANGE NAME	INVENTORY	AVERAGE SALARY
31	WESTON	1	TCH STF.	1	PRINCIL	1	COMMON	2	$ [redacted]250
				2	VICE-PR	1	COMMON	2	$ [redacted]750
				3	TEACHER	1	COMMON	51	$ [redacted]100
				4	DEPT HD	1	COMMON	17	$ [redacted]200
				5	FRENCH	1	COMMON	0	$ 0
32	YORK MEMORIAL	1	TCH STF.	1	PRINCIL	1	COMMON	1	$ [redacted]750
				2	VICE-PR	1	COMMON	1	$ [redacted]500
				3	TEACHER	1	COMMON	35	$ [redacted]100
				4	DEPT HD	1	COMMON	15	$ [redacted]400
				5	FRENCH	1	COMMON	0	$ 0
33	FRANK OKE	1	TCH STF.	1	PRINCIL	1	COMMON	1	$ [redacted]750
				2	VICE-PR	1	COMMON	1	$ [redacted]000
				3	TEACHER	1	COMMON	[illegible]8	$ [redacted]000
				4	DEPT HD	1	COMMON	0	$ 0
				5	FRENCH	1	COMMON	0	$ 0
34	YORK HUMBER	1	TCH STF.	1	PRINCIL	1	COMMON	1	$ [redacted]750
				2	VICE-PR	1	COMMON	1	$ [redacted]000
				3	TEACHER	1	COMMON	29	$ [redacted]900
				4	DEPT HD	1	COMMON	8	$ [redacted]606
				5	FRENCH	1	COMMON	0	$ 0
35	ARLINGTON SR.	1	TCH STF.	1	PRINCIL	1	COMMON	1	$ [redacted]500
				2	VICE-PR	1	COMMON	1	$ [redacted]300
				3	TEACHER	1	COMMON	34	$ [redacted]900
				4	DEPT HD	1	COMMON	0	$ 0
				5	FRENCH	1	COMMON	0	$ 0

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are presently employed at each school. (Figure 9) In addition, the average salaries of each are indicated for each school. This allows the model to do two things. First of all, the number of teachers required may be compared with the number of teachers presently employed at the school so that overages or shortages may be calculated. It also enables the model to determine total teaching staff salaries at each school.

Instructional Space is handled in very much the same way. Figure 10 shows page 8 of an inventory of instructional space at various schools. It shows that York Memorial has 24 classrooms with an absolute maximum size of 40 students and 4 classrooms with a maximum size of 15, etc. The existence of the space inventory allows the model to compare space requirements with available space and again indicate any overages or shortages.

6.5 INDIRECT RESOURCE REQUIREMENTS

In addition to the teaching staff and teaching space, individual schools require a number of other resources. Figure 11 indicates how the model deals with other resource requirements. For example, at the "School" cost center of York Memorial it indicates that $10.00 per student is required for text books.

FIGURE 10

SESSION 1969-70

INPUT DATA REPORTS 6.1
SOURCE DOCUMENTS SPACE 01
SPACE 02

SCHOOL SPACE INVENTORY

SCHOOL CODE	SCHOOL NAME	SPACE CODE	SPACE NAME	SPACE SUBTYPE CODE	SPACE SUBTYPE NAME	INVENTORY QUANTITY	INVENTORY UNIT	SIZE RANGE BREAKDOWN CODE	MAX. SIZE	QUANTITY
30	VAUGHAN ROAD	2	INST SP.	14	BIOLOGY	1		1	40	1
				15	CHEMISTRY	2		1	40	2
				16	TYPING	3		1	40	3
				17	BUS MACH	1		1	40	1
				25	BKKPNG	2		1	40	2
				30	MKTG+MCH	1		1	40	1
				35	POOL	1		1	40	1
				36	COMM PRC	1		1	40	1
				37	GEOG LAB	2		1	40	2
				38	SECRETAR	1		1	40	1
31	WESTON	2	INST SP.	1	CLASSRM	29		1	40	29
				3	ART RM.	1		1	40	1
				4	SCIENCE	2		1	40	2
				9	GYMN	2		6	50	2
				10	LIBRARY	1		6	50	1
				11	HOME EC.	2		1	40	2
				13	PHYSICS	1		1	40	1
				14	BIOLOGY	1		1	40	1
				15	CHEMISTRY	1		1	40	1
				16	TYPING	2		1	40	2
				17	BUS MACH	1		1	40	1
				18	AUTO SHP	1		1	40	1
				19	CARPENTY	1		1	40	1
				20	DRAFTIG	2		1	40	2
				22	MACH SHP	2		1	40	2
				23	SHT MET.	1		1	40	1
				25	BKKPNG	1		1	40	1
				30	MKTG+MCH	1		1	40	1
				32	ELERTON.	1		1	40	1
				38	SECRETAR	1		1	40	1
32	YORK MEMORIAL	2	INST SP.	1	CLASSRM	28		1	40	24
								5	15	4
				3	ART RM.	1		1	40	1
				8	MUSIC	1		1	40	1
				9	GYMN	4		6	50	4
				10	LIBRARY	1		6	50	1

FIGURE 11

SESSION 1969-70

INPUT DATA REPORTS 7.4
SOURCE DOCUMENTS& SUPPORT O
PAGE 21

SCHOOL INDIRECT RESOURCE REQUIREMENTS

SCHOOL CODE	SCHOOL NAME	RESOURCE COST CENTER CODE	RESOURCE COST CENTER NAME	RESOURCE TYPE CODE	RESOURCE TYPE NAME	RESOURCE SUBTYPE CODE	RESOURCE SUBTYPE NAME	FUNCTIONAL BASIS CODE	FUNCTIONAL BASIS NAME	QUANTITY IN PROPORTION
32	YORK MEMORIAL	53	SCHOOL MNTNC	7	OTHER	28	MAINTNC	6	ABSOLUTE - 100.0	903.00000
		36	SCHOOL OFFICE	5	SUP STF.	39	SEC CLER	2	PER STUDENT	.00590
		36	SCHOOL OFFICE	7	OTHER	1	BENEFITS	3	PER TOT STF SAL.	.05000
		36	SCHOOL OFFICE	3	ADM. SP.	1	OFFICE	304	PER SEC CLERICAL	100.00000
		36	SCHOOL OFFICE	7	OTHER	4	SUPPLIES	2	PER STUDENT	1.00000
		36	SCHOOL OFFICE	3	ADM. SP.	1	OFFICE	5	ABSOLUTE - 1.0	160.00000
		36	SCHOOL OFFICE	7	OTHER	4	SUPPLIES	2	PER STUDENT	16.00000
		91	SCHOOL	7	OTHER	26	TEXTBOOK	2	PER STUDENT	10.00000
		52	SCHOOL OPERATINS	5	SUP STF.	40	JANIT S	2	PER STUDENT	.01180
		52	SCHOOL OPERATINS	7	OTHER	1	BENEFITS	3	PER TOT STF SAL.	.10000
		52	SCHOOL OPERATINS	7	OTHER	4	SUPPLIES	5	ABSOLUTE - 1.0	5000.00000
		52	SCHOOL OPERATINS	7	OTHER	31	EXPENSES	6	ABSOLUTE - 100.0	200.00000
		52	SCHOOL OPERATINS	7	OTHER	24	INSURNC	5	ABSOLUTE - 1.0	2000.00000
		56	LIBRARY/RESOURCE	5	SUP STF.	37	LIB	2	PER STUDENT	.00154
		56	LIBRARY/RESOURCE	7	OTHER	4	SUPPLIES	2	PER STUDENT	6.00000
		56	LIBRARY/RESOURCE	7	OTHER	8	EQUIPMNT	2	PER STUDENT	1.50000
		56	LIBRARY/RESOURCE	3	ADM. SP.	1	OFFICE	303	PER LIBRARIAN	160.00000
		56	LIBRARY/RESOURCE	3	ADM. SP.	4	CONF INCE	2	PER STUDENT	6.00000
		56	LIBRARY/RESOURCE	5	SUP STF.	38	AST LIB	5	ABSOLUTE - 1.0	1.00000
		91	SCHOOL	7	OTHER	32	SUPPLY T	100	PER TEACHING STF	115.00000
		91	SCHOOL	7	OTHER	33	LAY AST	100	PER TEACHING STF	75.00000
		91	SCHOOL	7	OTHER	1	BENEFITS	3	PER TOT STF SAL.	.03000
33	FRANK OKE	53	SCHOOL MNTNC	7	OTHER	28	MAINTNC	6	ABSOLUTE - 100.0	302.00000
		36	SCHOOL OFFICE	5	SUP STF.	39	SEC CLER	2	PER STUDENT	.00590
		36	SCHOOL OFFICE	7	OTHER	1	BENEFITS	3	PER TOT STF SAL.	.05000
		36	SCHOOL OFFICE	3	ADM. SP.	1	OFFICE	304	PER SEC CLERICAL	100.00000
		36	SCHOOL OFFICE	7	OTHER	4	SUPPLIES	2	PER STUDENT	1.00000
		36	SCHOOL OFFICE	3	ADM. SP.	1	OFFICE	5	ABSOLUTE - 1.0	160.00000
		36	SCHOOL OFFICE	7	OTHER	4	SUPPLIES	2	PER STUDENT	16.00000
		91	SCHOOL	7	OTHER	26	TEXTBOOK	2	PER STUDENT	10.00000
		52	SCHOOL OPERATINS	5	SUP STF.	40	JANIT S	2	PER STUDENT	.01180
		52	SCHOOL OPERATINS	7	OTHER	1	BENEFITS	3	PER TOT STF SAL.	.16000
		52	SCHOOL OPERATINS	7	OTHER	4	SUPPLIES	5	ABSOLUTE - 1.0	5000.00000
		52	SCHOOL OPERATINS	7	OTHER	31	EXPENSES	6	ABSOLUTE - 100.0	200.00000
		52	SCHOOL OPERATINS	7	OTHER	24	INSURNC	5	ABSOLUTE - 1.0	2000.00000
		56	LIBRARY/RESOURCE	5	SUP STF.	37	LIB	2	PER STUDENT	.00154
		56	LIBRARY/RESOURCE	7	OTHER	4	SUPPLIES	2	PER STUDENT	6.00000
		56	LIBRARY/RESOURCE	7	OTHER	8	EQUIPMNT	2	PER STUDENT	1.50000

7. SAMPLE SIMULATION ANALYSES USING THE CONNECT/CLASS MODEL

7.1 ANALYSIS OF THE BASE CASE

The results of the base case simulation were described in general in Section 3. The complete output of the five year simulation consists of more than 1,000 separate reports. This includes a minimum of five reports which are available for each school for each of the five years that have been simulated. Obviously, a report such as this cannot provide a detailed review of all of the results. Attention will be focused here only on certain highlights which are considered of particular interest.

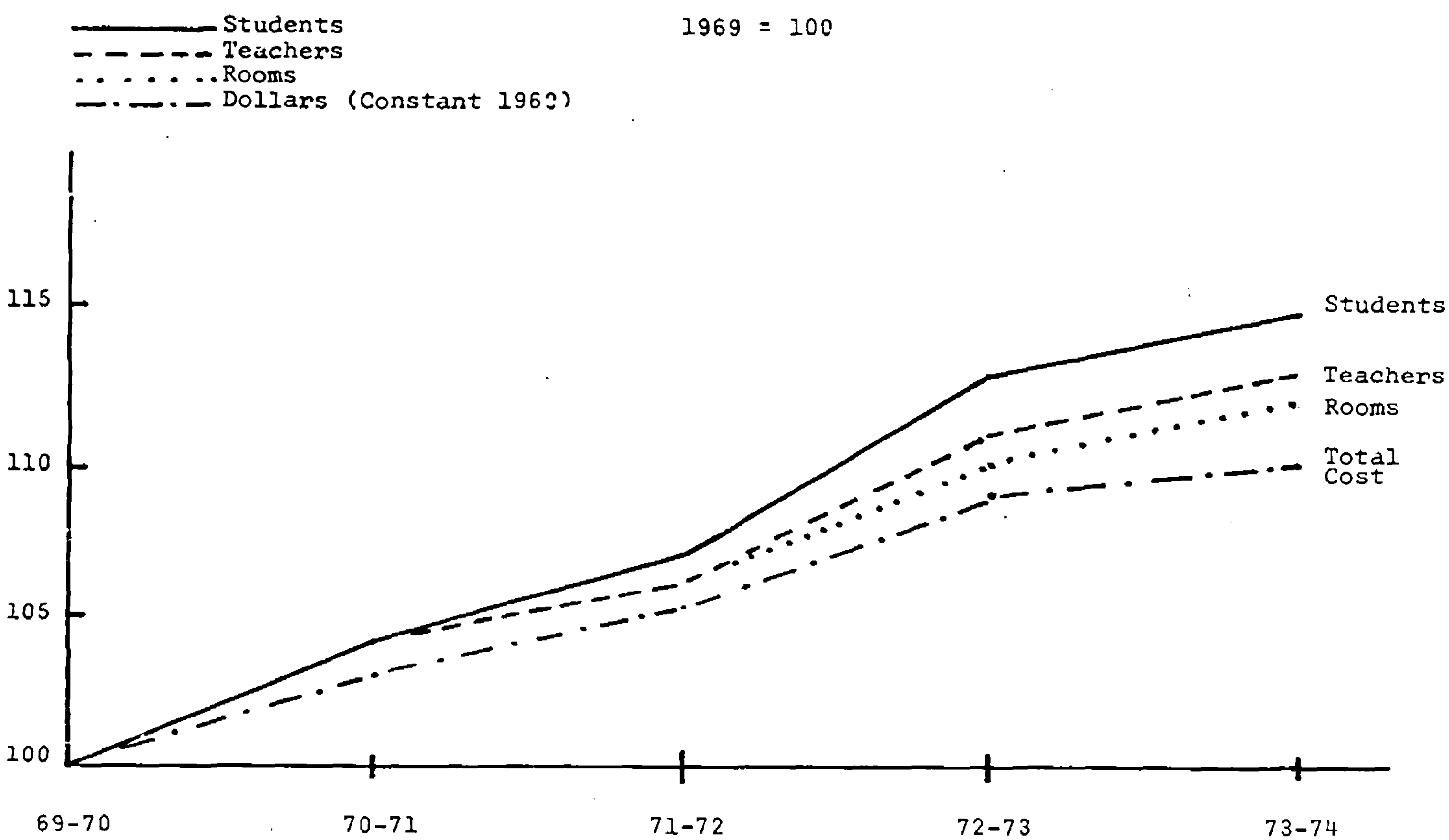
Report 1.1 on page 32 provides a comprehensive summary of the results of the five year base case simulation. It is interesting to observe the relative rate of increase of the number of students, teachers, rooms and total cost over the five year period which has been simulated. Figure 12 shows that over the five year period the number of students within the York Board of Education is expected to increase by approximately 15% . At the same time, the number of teachers is expected to increase only 13%, the number of instructional rooms required 12% and the total cost is expected to increase by only 10%. This, of course, indicates that the York Board of Education would be able to benefit from the economies of scale.

The results of the base case simulation, of course, depend directly on the information that has been input. Two rather sensitive areas in the simulation model are the number of hours that a teacher may be asked to teach and the number of hours per week that classrooms are actually being utilized. In order to determine the actual teaching load and classroom utilization for the 1969 - 1970 school year; the number of

FIGURE 12

YORK BOARD OF EDUCATION

RATE OF INCREASE : STUDENTS, TEACHERS, ROOMS, TOTAL COST



scheduled contact hours at each school as calculated by the simulation model was divided by the number of teachers that were employed at that school during the year and the number of classrooms that were available at each school. Figure 2 lists the average teaching load and average classroom utilization for each school of the York Board of Education. As indicated, the average teaching load at elementary schools was 22.2 hours and the average classroom utilization was 23.73 hours. It should be noted that the number of teachers includes the principal and vice-principal, if any, at each school but excludes the French teachers. However, the scheduled contact hours for French instructon at elementary schools was subtracted from the total number of contact hours.

At secondary schools the average teaching load is significantly below that of elementary school teachers. The average teaching load at all secondary schools was 16.14 hours per week. The classroom utilization was 22.31 hours per week. The average teaching loads at Frank Oke and York Humber appear to be above the average of the other secondary schools. However, the classroom utilization was just a bit below that of the elementary schools.

FIGURE 13

YORK BOARD OF EDUCATION 1969 - 1970		
SCHOOL	Average Teaching Load (Hours per Week)	Average Classroom Utilization (Hours per Week)
1. Briar Hill Jr.	23.07	25.54
2. C.E. Webster Jr.	21.79	21.21
3. Cordella Jr.	20.88	27.85
4. Dennis Ave. Jr.	24.87	25.13
5. H.J. Alexander Jr.	23.00	24.64
6. Keelesdale Jr.	22.94	19.79
7. King George Jr.	23.80	26.23
8. Lambton Park Jr.	25.63	26.06
9. Roseland Jr.	19.13	22.35
10. Warren Park Jr.	24.46	21.86
11. Weston Memorial Jr.	21.70	24.06
12. C.R. Marchant Sr.	15.95	21.31
13. Fairbank Sr.	19.81	25.94
14. Kane Senior	24.00	20.26
15. Cedarvale	25.00	25.76
16. Humbercrest	20.76	21.74
17. Humewood	25.81	31.97
18. J.R. Wilcox	22.96	20.38
19. Rawlinson	21.31	23.24
20. Bala Ave. Jr.	22.91	25.32
21. D.B. Hood Jr.	22.22	23.12
22. F.H. Miller Jr.	22.85	21.54
23. George Syme Jr.	23.59	24.85
24. Harwood Junior	23.20	22.48
25. Memorial Junior	22.12	25.14
26. Silverthorn Jr.	23.95	19.58
27. Rockcliffe	17.08	25.78
Average	22.21	23.73
28. George Harvey	16.90	24.77
29. Runnymede	14.77	20.60
30. Vaughan Road	16.49	21.62
31. Weston	14.96	19.31
32. York Memorial	17.32	25.03
Average	16.14	22.31
33. Frank Oke	18.65	19.63
34. York Humber	16.41	23.70
Average	17.17	22.02

7.2 ANALYSIS OF THE SYSTEM PROGRAM STRUCTURE

The type of program structure that has been developed for the York Board of Education and incorporated into the simulation model was described in Section 3 of this report. Figure 1 on page 16 provides a graphical representation of what is basically, a three dimensional look at the educational process.

Simulation results

Figure 14 on page 55 provides a summary report for the York Board of Education on the percentage distribution of scheduled class hours devoted to the teaching of each of the four system programs at elementary and secondary schools. As can be seen, the main emphasis at elementary schools is on the teaching of intellectual and communication skill (basically; reading, writing, arithmetic). In secondary schools the emphasis shifts towards the promotion of the personal development of individual students.

FIGURE 14

YORK BOARD OF EDUCATION

1969 - 1970

% DISTRIBUTION OF SCHEDULED HOURS

	Intellectual and Communications Skills	Environmental Studies	Individual Development	Social And Cultural Development	Total
	%	%	%	%	
Elementary Schools	43.62	7.41	25.28	23.50	99.81
Secondary* Schools	15.63	18.83	49.50	16.03	99.9
Average	35.45	10.64	32.74	21.18	100.01

* Excludes Frank Oke and York Humber

Figure 15 shows the dollar cost of teaching each of the system programs. From this it may be concluded that the implicit objectives of the York Board of Education are to put primary emphasis at elementary schools, on the teaching of basic skills, followed by individual development, social and cultural development and environmental studies. At the secondary schools the order of priorities has changed. Implicitly the first priority at secondary schools is the promotion of individual development, followed by environmental studies, social and cultural development and basic skills.

It is very interesting to see how individual schools compare with the averages for the system. Figures 16 and 17 provide the percentage distribution of scheduled class hours for each of the four system programs at each elementary and secondary schools for the 1969 - 1970 school year. What is surprising, is the significant differences that may be found between schools. For example, C. E. Webster Junior devotes 56% of total class hours to the teaching of basic skills, whereas Rockcliffe Senior School only devotes 27 percent to the same activities. The teaching of environmental studies varies from 3% at King George Junior to 17% at Rockcliffe Senior. The promotion of individual development varies from 21% at King George Junior and Humewood to 35% at Fairbank Senior. The promotion of social and cultural development varies from 14% at C. E. Webster Junior to 38% at F. H. Miller Junior School.

At secondary schools the teaching of basic skills varies from 8% at Runnymede to 19% at York Memorial. Teaching of environmental studies varies from 14% at Weston to 23% at York Memorial. The promotion of individual development varies from 42% at York Memorial to 58% at George Harvey. The promotion of social and cultural development varies from 11% at George Harvey to 18% at Vaughan Road and Weston.

FIGURE 15

YORK BOARD OF EDUCATION

1969 - 1970

COST OF SYSTEM PROGRAMS

	Intellectual and Communications Skills	Environmental Studies	Individual Development	Social And Cultural Development	Total
	$	$	$	$	$
Elementary Schools	4.482.501	761.470	2.597.836	2.415.919	10.257.726
Secondary* Schools	1.137.786	1.370.729	3.603.352	1.166.903	7.278.770
Total	5.620.287	2.132.199	6.201.188	3.582.822	17.536.496

* Excludes Frank Oke and York Humber

FIGURE 16

ELEMENTARY SCHOOLS	% DISTRIBUTION OF SCHEDULED HOURS				
	Intellectual and communication skills	Environmental studies	Individual development	Social and cultural development	TOTAL
1. Briar Hill Jr.	38	9	24	28	99
2. C.E. Webster Jr.	56	5	26	14	101
3. Cordella Jr.	44	5	23	29	101
4. Dennis Ave. Jr.	36	4	26	33	99
5. H.J. Alexandr Jr.	54	4	23	20	101
6. Keelesdale Jr.	52	4	27	16	99
7. King George Jr.	40	3	21	34	98
8. Lambton Park Jr.	48	4	23	25	100
9. Roseland Jr.	56	5	23	15	99
10. Warren Park Jr.	51	4	27	20	102
11. Weston Mem. Jr.	39	6	28	27	100
12. C.R. Marchant Sr.	46	13	31	10	100
13. Fairbank Sr.	30	14	35	21	100
14. Kane Senior	47	10	26	16	99
15. Cedarvale	44	8	27	21	100
16. Humbercrest	40	9	29	22	100
17. Humewood	47	6	21	27	101
18. J.R. Wilcox	36	8	29	26	99
19. Rawlinson	47	6	24	23	100
20. Bala Ave. Jr.	43	7	22	27	99
21. D.B. Hood Jr.	30	13	25	32	100
22. F.H. Miller Jr.	34	5	23	38	1[illegible]
23. George Syme Jr.	51	4	25	20	100
24. Harwood Junior	53	4	22	21	100
25. Memorial Junior	45	13	22	21	101
26. Silverthorn Jr.	47	4	26	23	100
27. Rockcliffe Sr.	27	17	32	24	100
AVERAGE	43.62	7.41	25.[illegible]3	23.50	99.81

FIGURE 17

SECONDARY SCHOOLS	% DISTRIBUTION OF SCHEDULED HOURS				
	Intelectual and communication skills	Environ-mental studies	Individual development	Social and cultural develop-ment	TOTAL
28. George Harvey	16	16	58	11	101
29. Runnymede	8	22	52	17	99
30. Vaughan Road	17	19	45	18	99
31. Weston	18	14	50	18	100
32. York Memorial	19	23	42	16	100
TOTAL	15.63	18.83	49.50	16.03	99.9

The obvious queston that arises from the information on system programs is: what significance may be attached to the rather substantial variation of the character and content of the teaching program at each school? Additional research should be directed towards finding out whether, for example, the amount of time spent on teaching of basic skills directly has an effect on the subsequent performance of students in secondary schools, post-secondary schools or elsewhere.

7.3 ANALYSIS OF THE IMPLICATIONS OF INCREASED ENROLLMENT

In order to test the sensitivity of enrollment on various resources, a simulation was run in which enrollment at the five regular secondary schools was increased significantly. Specifically, enrollment was increased in 1971 - 1972 by 1,305, in 1972 - 1973 by 1,680 and in 1973 - 1974 by 1,963. A summary of the results is provided on Figures 21 and 22. In order to compare the results of this particular simulation with the results of the base case, the following table provides a brief summary of the two enrollment patterns, the number of teachers required, the number of instructional rooms required and the cost per student for both the base case and the simulation in which the enrollment was significantly increased.

TABLE

ENROLLMENT	1971-1972	1972-1973	1973-1974
-Base Pattern	6,710	7,081	7,136
-High Pattern	8,015	8,761	9,099
TEACHERS' REQUIREMENTS			
-Base Pattern	1,154	1,200	1,222
-High Pattern	1,191	1,247	1,278
ROOMS REQUIRED			
-Base Pattern	978	1,015	1,032
-High Pattern	1,015	1,070	1,093
COST/STUDENT			
-Base Pattern	947	934	947
-High Pattern	864	838	836

FIGURE 21

REPORT NO. 1.1

PAGE 1

YORK BOROUGH BOARD OF EDUCATION
SUMMARY REPORT
****

	1969-70	1970-71	1971-72	1972-73	1973-74
ENROLMENT (NO.)					
1 ELEMENTARY K - 6	12445	12819	13172	13951	13976
2 ELEMENTARY 7 + 8	3121	3109	3472	3705	3886
3 JR. KINDERGARTEN	486	1003	1026	1026	1026
4 SECONDARY 9 - 13	6694	6822	8015	8761	9099
5 PRIMARY OPPORT:Y	66	66	60	60	60
6 JUNIOR OPPORT:Y	83	115	80	80	80
7 INT. OPPORTUNITY	81	50	32	48	48
8 SLD - BEHAVIOUR	20	15	8	8	8
9 SLD - PERCEPTUAL	7	0	40	48	48
10 CANADIAN C.C.	38	65	65	65	65
11 OCCUPATIONAL	462	474	538	614	678
12 SPEC. VOCATIONAL	260	254	257	260	263
TOTAL	23763	24792	26765	28626	29237
STAFF (NO.)					
TEACHING	1083	1130	1191	1247	1278
NON-TEACHING	506	521	556	581	591
SPACE					
INSTRUCTIONAL (ROOMS)	920	953	1015	1070	1093
ADMINISTRATIVE (SQ. FT)	182573	189857	202895	215401	219747
SERVICE	0	0	0	0	0
BOARD OFFICES	0	0	0	0	0
EXPENDITURES ($)					
TEACHING STAFF	10731123	11187943	11772188	12304360	12583249
NON-TEACHING STAFF	3348301	3436239	3657449	3846815	3919128
EQUIPMENT	0	0	0	0	0
OTHER	4540786	4622712	4728735	4820795	4859274
TOTAL	18620210	19246894	20158372	20971970	21361651

FIGURE 22

REPORT NO. 1.1

PAGE 2

YORK BOROUGH BOARD OF EDUCATION
SUMMARY REPORT
****

INDICATORS:	1969-70	1970-71	1971-72	1972-73	1973-74
STUDENT / TEACH					
JUNIOR SCHOOL	26	26	26	27	27
SENIOR SCHOOL	20	20	23	23	24
COMPOSITE SCHOOL	27	23	23	23	23
INNER-CITY JR.	27	28	28	28	28
INNER-CITY SR.	20	20	21	23	24
INNER-CITY COMP.	0	0	0	0	0
SECONDARY SCHOOL	17	17	18	18	18
OPPORTUNITY	13	12	12	13	13
OCCUPATIONAL	11	12	12	12	12
STUDENT / TOT SF					
JUNIOR SCHOOL	18	18	19	19	19
SENIOR SCHOOL	15	15	17	17	18
COMPOSITE SCHOOL	28	17	17	17	17
INNER-CITY JR.	19	20	20	20	20
INNER-CITY SR.	16	16	16	18	18
INNER-CITY COMP.	0	0	0	0	0
SECONDARY SCHOOL	12	12	13	13	13
OPPORTUNITY	9	9	9	9	9
OCCUPATIONAL	9	9	9	9	9
AVERAGE CLASS SZ					
JUNIOR SCHOOL	0	0	0	0	0
SENIOR SCHOOL	0	0	0	0	0
COMPOSITE SCHOOL	0	0	0	0	0
INNER-CITY JR.	0	0	0	0	0
INNER-CITY SR.	0	0	0	0	0
INNER-CITY COMP.	0	0	0	0	0
SECONDARY SCHOOL	0	0	0	0	0
OPPORTUNITY	0	0	0	0	0
OCCUPATIONAL	0	0	0	0	0
COST / STUDENT					
JUNIOR SCHOOL	519	501	498	486	487
SENIOR SCHOOL	673	667	590	579	586
COMPOSITE SCHOOL	470	603	613	594	605
INNER-CITY JR.	501	481	481	474	471
INNER-CITY SR.	604	601	583	508	51[illegible]
INNER-CITY COMP.	0	0	0	0	0
SECONDARY SCHOOL	937	923	864	838	836
OPPORTUNITY	1320	1347	1334	1320	1307
OCCUPATIONAL	1311	1282	1238	1198	1157

A significant result of the simulation is illustrated on Figure 23 , which shows the relative rate of increase of the number of students, the number of teachers required, the number of instructional rooms required and the total cost. This graph should be compared with Figure 12 on page 51 which shows the relative rate of increase for each of the four variables in the base case. The most significant difference to be observed is that in the base case the number of teachers required increases at a faster rate than the number of instructional rooms required. In this simulation that situation is exactly reversed. The number of rooms required increases at a faster rate than the number of teachers required. This may be explained by the fact that the high school program requires a number of specialized laboratories. At the same time, the input data specifies only one general type of high school teacher.

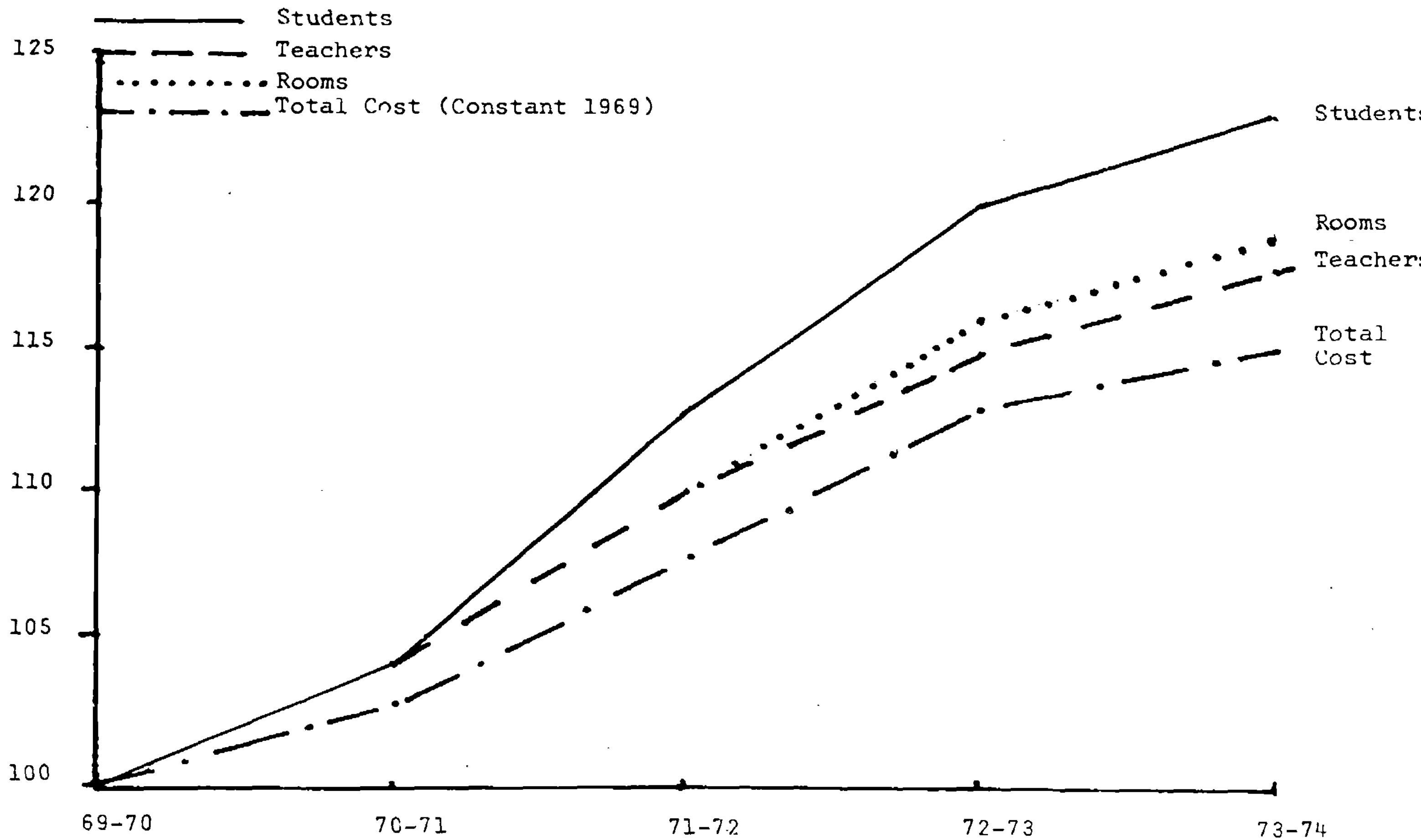
In other words, if the input would specify that Chemistry teachers could only teach Chemistry and that Physics teachers could only teach Physics,etc., then the number of teachers required would probably increase at the same rate as the number of rooms required. However, since according to the present input the teacher requirements are completely flexible and the room requirements are very specific, the rate of increase in the number of rooms required may be expected to be higher than the rate of increase for the number of teachers required.

FIGURE 23

YORK BOARD OF EDUCATION

RATE OF INCREASE : STUDENTS, TEACHERS, ROOMS, TOTAL COST

1969 = 100



4 ANALYSIS OF THE FRENCH PROGRAM

In order to determine the impact on resource requirements of a change in the educational program, three different simulations were run in which significant changes to the French program at elementary schools were introduced. At present French is taught starting at the grade 3 level, through to grade 8.

In the first simulation the complete French program in elementary schools was eliminated. In the second simulation French was introduced into grade 2 during the 1970 - 1971 school year. The French program would basically consist of four twenty minute periods for all children at the grade 2 level and up. The maximum class size would be 32. In the third simulation the French program was introduced in to grade 1 for the 1971 - 1972 school year. It would be similar to that specified for grade 2.

Table 1 gives an overview of the financial costs involved: first of all, for the existing program, secondly, for introducing French into grade 2 and thirdly, for introducing French into grade 1. The cost includes what was considered to be a fair allocation of overhead expenditures.

In the base case the cost of the French program increases from $342,000 in the 1969 - 1970 school year to $413,000 in the 1971 - 1972 school year. The introduction of French at the grade 2 level in 1970 - 1971 increases the cost of the French program for that year from $383,000 to $449,000, an increase of $66,000. The further extension of the French program into grade 1 in the 1971 - 1972 school year increases the cost of the French program from $413,000 to $553,000, an increase of $140,000.

A further analysis of this information indicated that the cost of teaching one child for one hour would be approximately .60¢.

TABLE 1

COST OF EXTENDING THE FRENCH PROGRAM

YEAR	GRADES 3-8	GRADES 2-8	GRADES 1-8	INCREASE
69/70	$342,000	$	$	$
70/71	383,000	449,000		66,000
71/72	413,000		553,000	140,000

In addition to affecting cost, the introduction of the French program has a noticeable effect on the number of class rooms required. Table 2 indicates that the incremental number of classrooms required to teach French in grade 3 to 8 would be 20. Introducing French into grade 2 during the 1970 - 1971 school year resulted in an increase of two in the number of classrooms required. The introduction of French in grade 1 during the 1971 - 1972 school year resulted in a further increase of four in the number of classrooms required. A more detailed analysis of classroom requirements at individual schools would enable the user of the simulation model to determine exactly at what schools the additional rooms would be required.

TABLE 2

NUMBER OF CLASSROOMS REQUIRED

1969	No French	573 classrooms
1969	French in Grades 3 - 8	593 classrooms (+20)
1970	French in Grades 2 - 8	595 classrooms (+22)
1971	French in Grades 1 - 8	599 classrooms (+26)

Table 3 indicates the impact of the changes in the French program on the number of teachers required. The calculation of the number of teachers required is based on the assumption that French teachers would be required to work 28 hours a week. This, in fact , seldom is the case. Therefore, it might have been more realistic if the policy regarding the number of hours that French teachers may be asked to teach had been reduced by several hours. However, given the assumptions that were fed into the computer, the simulation model calculated that the number of teachers required to teach the existing French program (from grade 3 - grade 8) would increase from 20 in the 1969 - 1970 school year to 24 in the 1971 - 1972 school year. The introduction of French in grade 2 in the 1970 - 1971 school year results in an increase of 4 in the number of French teachers required. The further introduction of French into grade 1 results in an increase of 9 in the number of French teachers required.

TABLE 3

NUMBER OF FRENCH TEACHERS REQUIRED

SCHOOL YEAR	BASE CASE	FRENCH GR. 2-8	FRENCH GR. 1-8	
1969-1970	20			
1970-1971	22	26		(+4)
1971-1972	24		33	(+9)

reduction of class size

A fourth experiment was run in which the class size policy for all French classes throughout the system in grade 9 - 13 was reduced from 30 students per class to 20 students per class. The results of the simulation indicated that an additional 9 classrooms would be required at the secondary schools. Specifically, two additional rooms were required at York Memorial, one additional room at Weston, four additional rooms at Vaughan Road, two additional rooms at Runnymede and three additional rooms at George Harvey. However, only York Memorial would have needed additional teachers (two) to accommodate the increased work load.

7.5 TRADE-OFF ANALYSIS: TEACHING LOAD vs CLASS SIZE

Two of the sensitive variables in the model are teaching load and class size. In addition, these two variables appear to be rather critical in the educational process as such. It is therefore interesting to find out what would happen if these variables were to change. In order to do so, three simulations were prepared.

In the first simulation the average number of hours that teachers may be required to teach was reduced by approximately 10%. Specifically the following reductions were made:

STAFF TYPE	BASE CASE	REDUCED TEACHING LOAD
Elementary school Vice-Principals	10	9
Elementary school teachers	28	25
Elementary school French teachers	28	25
Secondary school department heads	8	7
Secondary school teachers	18	16

Note: Neither Elementary or Secondary school Principals are available for teaching on a regularly scheduled basis.

In the second simulation the average maximum class size was increased by approximately 10%. Specifically the following changes were made:

OPERATING PROGRAM	BASE CASE	INCREASED CLASS SIZE
Junior Kindergarten	20	22
Elementary K to 6	32	35
Secondary 9 to 13	32	35
Opportunity Classes	16	18
Primary Opportunity	12	14
SLD Classes	8	10

For the third simulation both of the changes described above were affected at the same time. Thus, the teaching staff load was decreased by 10% and class size was increased by 10%. The figures on the following two pages present the results of the three simulations. Figure 24 provides a summary of the total number of the teachers required and the number of rooms required for (a) the BASE CASE (b) REDUCED TEACHING LOAD (c) INCREASED CLASS SIZE (d) BOTH, REDUCED TEACHING LOAD AND INCREASED CLASS SIZE.

It may be seen that for the 1969 - 1970 school year an additional 111 teachers would have been required if the teaching load had been decreased by 10%. However, if class size had been increased by 10% then 71 less teachers would have been required. However, by reducing teaching load and increasing class size the total number of teachers required would have increased by only 27 teachers.

The number of rooms required obviously is not affected by reducing the [illegible] load of teachers. However, it is significantly affected by an increased class size. By increasing the maximum number of children allowed in a particular class at one time by 10% the total number of rooms required decreases by 68 in the 1969 - 1970 school year and by 81 in the 1973 - 1974 school year. This, of course, assumes that existing classrooms can accommodate the extra 10%. Since this is only an increase from 32 children to 35 per class this is a reasonable assumption. However, if class size was increased further than the physical limit of particular rooms, as specified in the model, might be exceeded and thereby drastically increase the number of new rooms required.

Figure 25 compares the relative rate of increase in teacher requirements for each of the four cases. It is immediately

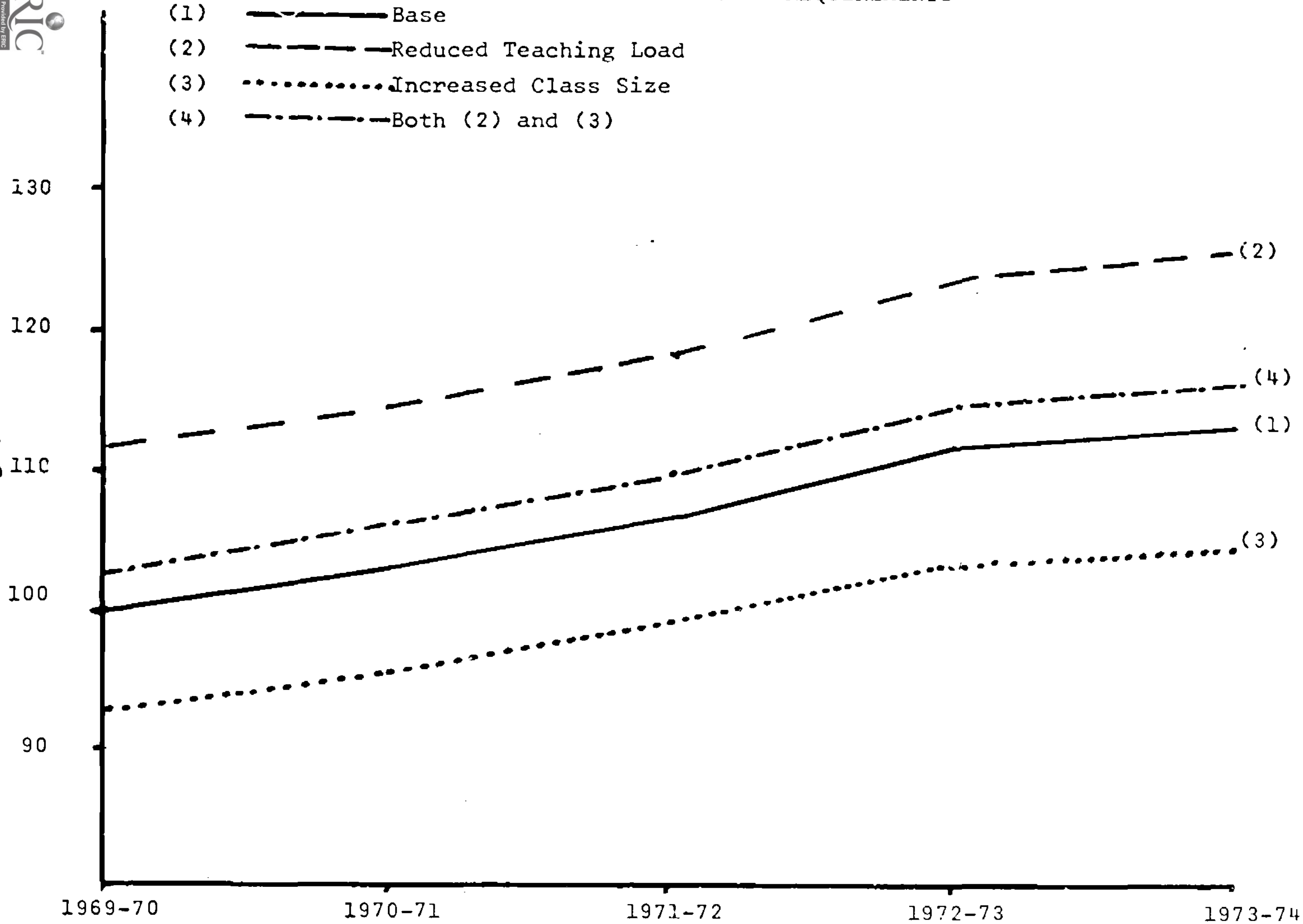
FIGURE 24

YORK BOARD OF EDUCATION								
	A. Base Case	B. Reduced Teaching Load (10%)		C. Increased Class Size (10%)		D. B. and C.	
Number of Teachers Required			B-A		C-A		D-A
1969-70	976	1087	+111	905	-71	1003	+27
1970-71	1008	1121	+113	933	-75	1035	+27
1971-72	1037	1154	+117	966	-71	1070	+33
1972-73	1087	1207	+120	1008	-79	1120	+33
1973-74	1101	1223	+122	1017	-84	1132	+31
Number of Rooms Required					C-A		
1969-70	920			852	-68		
1970-71	953			882	-71		
1971-72	978			912	-66		
1972-73	1015			948	-67		
1973-74	1032			951	-81		

FIGURE 25

YORK BOARD OF EDUCATION

RATE OF INCREASE OF TEACHER REQUIREMENTS



apparent that a 10% decrease of the work load of teachers may be cancelled out just about completely by increasing class size.

The results of the simulations described above would indicate that additional research should be directed at determining the cumulative effect of decreasing the teaching load of the teaching staff and decreasing class size at the same time. Obviously, such results would be significant background material for negotiations with the Teachers Federation.

7.6 ANALYSIS OF THE EFFECT OF INFLATION

In order to calculate the cumulative effect of increasing enrollment, increasing staff requirements and the possibility of a 8% average annual salary increase, a simulation was run in which the salaries of teaching and non-teaching staff at the schools of the York Board of Education was increased by 8% per year. Figure 27 provides a summary of the results of that simulation.

In the base case the total budget for teaching salaries is expected to increase from 10.5 million in 1969 - 1970 to 11.8 million in 1973 - 1974. This represents an increase of approximately $1.3 million. This is solely the result of an increase of 139 in the total number of teachers that will probably be required by 1973 - 1974. It does not include any promotions or salary increases. However, if we assume that salaries will increase at an average rate of 8% per year for the next few years then, as the simulation results indicate, the total budget for teaching salaries should increase from 10.5 million in 1969 - 1970 to 16.0 million in 1973 - 1974. This represents an approximate increase of $5.5 million over five years.

Similarly, the budget for non-teaching salaries may increase from 2.1 million to 3.2 million, an increase of $1.1 million. Since fringe benefit costs are a direct function of the total salaries, they may also be expected to increase. Figure 1 indicates that the probable increase would be from $460,000 in 1969 - 1970 to approximately $700,000 in 1973 - 1974, an increase of about $240,000.

FIGURE 27

YORK BOARD OF EDUCATION					
THE EFFECT OF A 8% AVERAGE ANNUAL SALARY INCREASE					
	Teaching Salaries	Non-Teaching* Salaries	Fringe Benefits	Total	%
Base Case					
1969-70	10.586.683	2.102.237	460.181	13.149.101	100
1970-71	11.029.059	2.183.586	479.687	13.692.332	104
1971-72	11.265.934	2.233.792	489.321	13.989.052	106
1972-73	11.639.811	2.365.868	510.764	14.516.443	110
1973-74	11.891.712	2.401.644	518.275	14.811.631	112
8% Inflation					
1969-70	10.586.683	2.102.237	460.181	13.149.101	100
1970-71	11.910.601	2.358.243	518.058	14.786.902	112
1971-72	13.118.612	2.605.475	570.219	16.294.306	123
1972-73	14.629.617	2.980.292	640.821	18.250.730	139
1973-74	16.013.095	3.267.422	700.925	19.981.442	152

* Excludes Salaries of Board Officials and Staff.

The total cumulative effect of an 8% average annual salary increase would be that inflation alone will cost the York Board of Education at least \$6.8 million by 1973 - 1974. In other words, according to the simulation, the York Board of Education will have to pay out at least an additional \$12,303,922 in the next four years because of inflation.

7.7 ANALYSIS OF PHYSICAL FACILITIES

The simulation model has been programed to calculate the physical facilities required to conduct the program as specified by each individual school. Three main categories of physical facilities have been defined in the input data:

(1) Instructional space
(2) Administrative space
(3) Ancillary space

Within Instructional space the following sub-types have been identified:

- Classroom
- Kindergarten Classroom
- Junior Kindergarten Classroom
- Primary Opportunity Classroom
- Junior Opportunity Classroom
- Intermediate Opportunity Classroom
- Art Room
- Science Room
- Home Economics
- Industrial and Applied Crafts
- Music Room
- Physics Lab
- Biology Lab
- Chemistry Lab
- Typing Room
- Business Machines
- Data Processing
- Library
- Gymnasium

For each of the approximately 140 activities that have been defined, the user may specify the type of instructional space that is required. For example, Junior Kindergarten

activities take place mostly in the Junior Kindergarten Classroom. The number of rooms of each type that are available at each school is specified in the inventory of space for the model. (Input document: space 01) It therefore becomes possible for the simulation model to compare the number of rooms required with the number of rooms that are presently available and to indicate deficits or surpluses of classrooms.

Figures 28 and 29 provide a detailed review of (a) the number of rooms and portables available at each school according to the input data, (b) the number of rooms required at each school, and (c) the deficit or surplus of rooms at each school. It must be remembered, that the calculations are based strictly on the assumptions that have been fed into the model. The key assumptions are:

(1) Length of teaching week: 28 hours
(2) Maximum classroom utilization: 95%
(3) Maximum laboratories utilization: 85%

The results indicate that, on the basis of the enrollment projection made, the York Board of Education must provide an additional 10 classrooms at elementary schools and 15 classrooms at secondary schools over the next four years.

Figures 28 and 29 indicate a rather significant surplus of classrooms at elementary schools in the first years of the simulation. This is probably because the maximum utilization. rates specified in the input are higher than is the case in reality. In order to test the sensitivity of the maximum utilization rates a simulation was run in which the utilization rates as specified above were decreased by 15%. Figure 30 shows that a decrease of 15% in the utilization results in an increase of 173 in the number of instructional rooms

BASE CASE: ELEMENTARY SCHOOLS

FIGURE 28

SCHOOL	Inventory 1969-1970 Rooms	Inventory 1969-1970 Portable	Inventory 1969-1970 Total	1969-1970 Required	1969-1970 Def. or Surp.	1970-1971 Required	1970-1971 Def. or Surp.	1971-1972 Required	1971-1972 Def. or Surp.	1972-1973 Required	1972-1973 Def. or Surp	1973-1974 Required	1973-1974 Def. or Surp.
1. Briar Hill Jr.	12		12	12	0	14	-2	17	-5	17	-5	17	-5
2. C.E. Webster Jr.	24		24	20	4	20	4	18	6	18	6	19	5
3. Cordella Jr.	8	4	12	14	-2	14	-2	14	-2	14	-2	14	-2
4. Dennis Ave. Jr.	13		13	15	-2	15	-2	13	0	13	0	13	0
5. H.J. Alexander Jr.	11		11	11	0	12	-1	12	-1	18	-7	18	-7
6. Keelesdale	17	2	19	16	3	16	3	17	2	18	1	18	1
7. King George Jr.	11	1	12	12	0	12	0	12	0	12	0	12	0
8. Lambton Park Jr.	18		18	19	-1	19	-1	18	0	20	-2	19	-1
9. Roseland Jr.	20		20	17	3	17	3	17	3	21	-1	20	0
10. Warren Park Jr.	14		14	12	2	12	2	12	2	17	-3	16	-2
11. Weston Mem. Jr.	17		17	15	2	14	3	14	3	15	2	15	2
12. C.R. Marchant Sr.	15	1	16	15	1	17	-1	13	3	14	2	14	2
13. Fairbank Sr.	16		16	18	-2	18	-2	19	-3	19	-3	21	-5
14. Kane Senior	27		27	20	7	17	10	19	8	22	5	22	5
15. Cedarvale	18	1	19	18	1	13	6	12	7	12	7	12	7
16. Humbercrest	27		27	23	4	23	4	23	4	23	4	23	4
17. Humewood	29	5	34	4[illegible]	-8	36	-2	37	-3	38	-4	39	-5
18. J.R. Wilcox	25	1	26	23	3	18	8	18	8	18	8	17	9
19. Rawlinson	45	4	49	46	3	39	10	42	7	41	8	42	7
20. Bala Ave. Jr.	16	2	18	18	0	18	0	19	-1	19	-1	19	-1
21. D.B. Hood Jr.	23		23	21	2	21	2	20	3	19	4	18	5
22. F.H. Miller Jr.	12		12	10	2	10	2	10	2	10	2	10	2
23. George Syme Jr.	16	4	20	19	1	28	-8	30	-10	30	-10	30	-10
24. Harwood Jr.	17	5	22	20	2	20	2	21	1	21	1	22	0
25. Memorial Jr.	26		26	26	0	27	-1	28	-2	27	-1	27	-1
26. Silverthorn Jr.	24	2	26	20	6	20	6	21	5	21	5	22	4
27. Rockcliffe Sr.	23		23	25	-2	25	-2	28	-5	29	-6	29	-6
28. Arlington Sr.(1970.)	(28)		(28)			27	+1	41	-13	42	-14	46	-18
T O T A L	524 (552)	32	556 (584)	527	29	542	42	565	19	588	-4	594	-10

NOTE: This table does not include: Libraries, Gyms, Pools and Junior Kindergartens.

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BASE CASE: SECONDARY SCHOOLS

	INVENTORY	REQUIRED									
	1969-70	1969-70		1970-71		1971-72		1972-73		1973-74	
	ROOMS	ROOMS	Def. or Surp.	ROOMS	Def. or Surp.	ROOMS	Def. or Surp.	ROOMS	Def. or Surp.	ROOMS	Def. or Surp
28. George Harvey	69	73	-4	75	-6	74	-5	71	-2	69	0
29. Runnymede	45	43	2	43	2	41	4	40	5	40	5
30. Vaughan Road	53	51	2	52	1	55	-2	63	-10	68	-15
31. Weston	51	47	4	47	4	43	8	42	9	40	11
32. York Memorial	36	42	-6	42	-6	43	-7	45	-9	48	-12
33. Frank Oke	19	15	4	15	4	15	4	15	4	16	3
34. York Humber	27	25	2	25	2	29	-2	33	-6	36	-9
TOTAL	300	296	4	299	1	300	0	309	-9	317	-17

Note: This table does not include:
Libraries, Gyms and Pools.

FIGURE 29

required, an increase of 18.8%.

Another important variable in the calculation of physical facilities requirements is the length of the teaching week. In order to demonstrate the effect of a change in the length of the teaching week on the requirements of physical facilities a simulation was in which the length of the teaching week was increased by 25% (from 28 - 35). Figure 30 shows that a 25% increase in the length of the teaching week would result in a decrease of 166 in the number of instructional rooms required. This represents a decrease of 18%.

The above gives some indication of the type of analysis that may be performed in the area of physical facilities. Before these results may be used for physical facilities planning at the York Board of Education, some further thought should be given to what precisely the maximum utilization rate and length of the teaching week should be. In the analysis of the base case an indication was given as to the actual number of scheduled classroom hours at each individual school. Using that information, more acurate utilization rates may be calculated.

FIGURE 30

YORK BOARD OF EDUCATION

YEAR	A. BASE CASE	B. 15% DECREASE IN UTILIZATION		C. 25% INCREASE IN LENGTH OF TEACHING WEEK	
			B-A		C-A
1969-70	920	1093	+ 173	754	-166
1970-71	953	1129	+ 176	784	-169
1971-72	978	1159	+ 181	801	-177
1972-73	1015	1206	+ 191	835	-180
1973-74	1032	1220	+ 188	848	-184

8.1 A GENERALIZED DESIGN FOR CONNECT/CLASS

The Systems Research Group is currently in the early design stages of a generalized version of CONNECT/CLASS, a computer based school board management system which will be able to quickly and economically perform analyses on historical, current and planning data. This system is designed to comprise a series of computer modules that can be assembled according to tasks the user requests. These tasks can vary in complexity from a simple retrieval of historical data to a 10 year simulation of all aspects of school operations. The system is being designed to enable a non-technical user to make full use of its capabilities. The user simply requests tasks through English based verbal commands irrespective of the complexity of the computer's operation. A schematic of the total system is illustrated in Figure 1. The system is broken down into three main areas:

(1) The data input system is designed to input large volumes of data and build up the necessary files to run the system. These files include the permanent data base files, the permanent report files for both board and school and the ISF files containing information on space, staff, programs and students.

(2) The simulation system is comprised of a user input system that is designed to interface the non-technical user with the simulator itself. An example of such an interactive system can be seen on page 11.

(3) An output system - the output system includes the ability to output reports requested during the simulation run and to provide some type of analysis. This analysis may consist of either exception report analysis or statistical analysis or both.

FIGURE 1

CONNECT/CLASS

A Generalized Design

Phase 1 - Data Input System

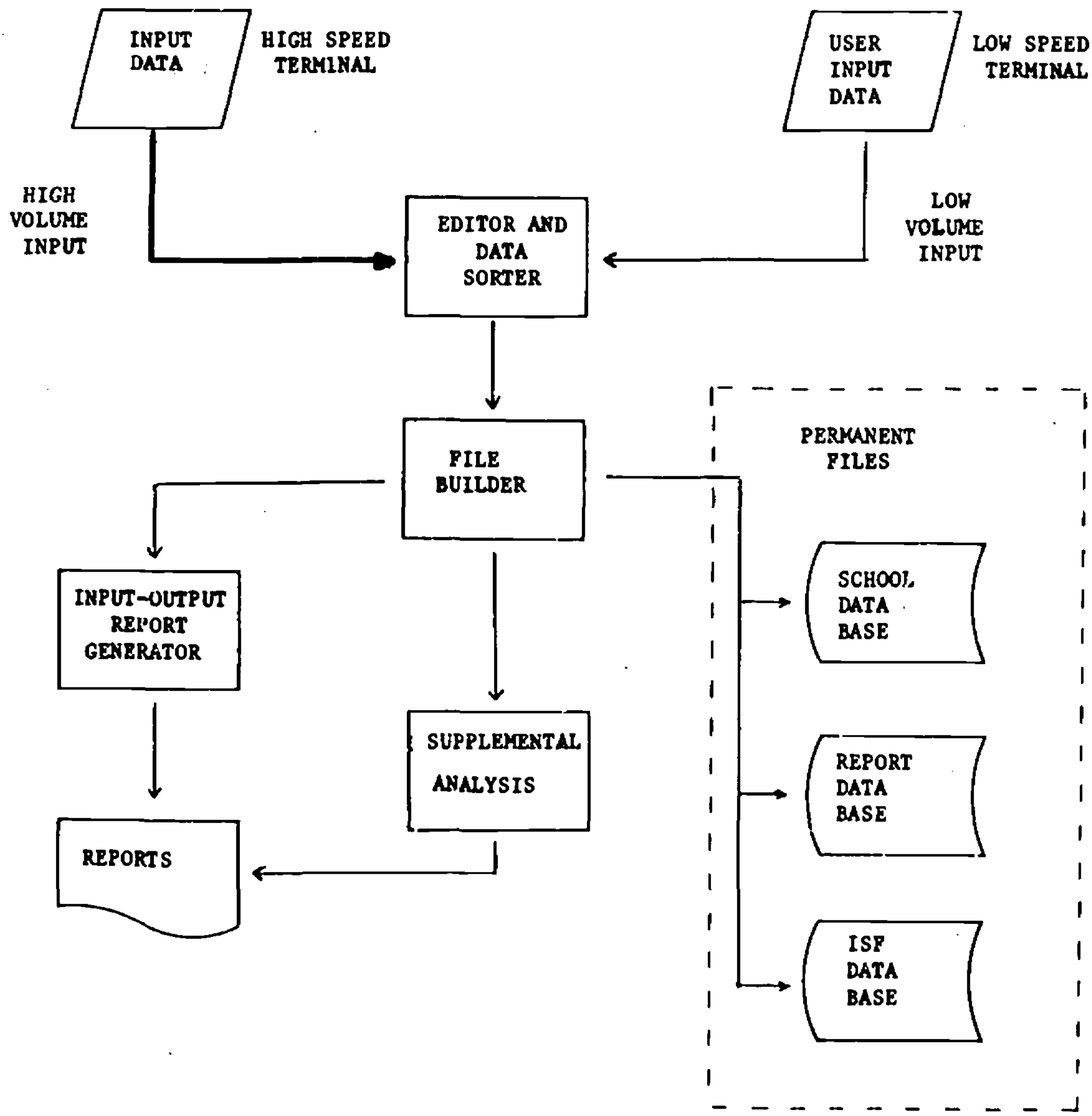


FIGURE 1 (cont'd)

CONNECT/CLASS

A Generalized Design

Phase 2 - Simulation System

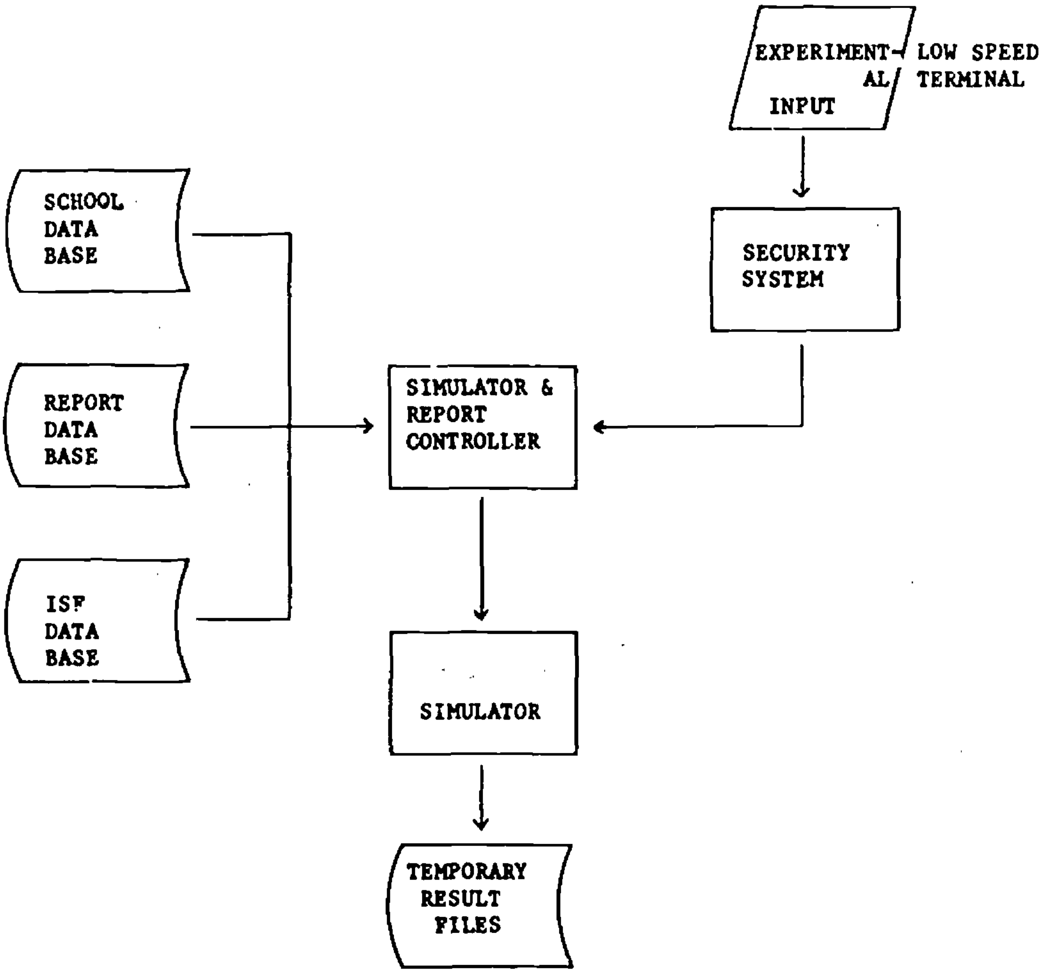
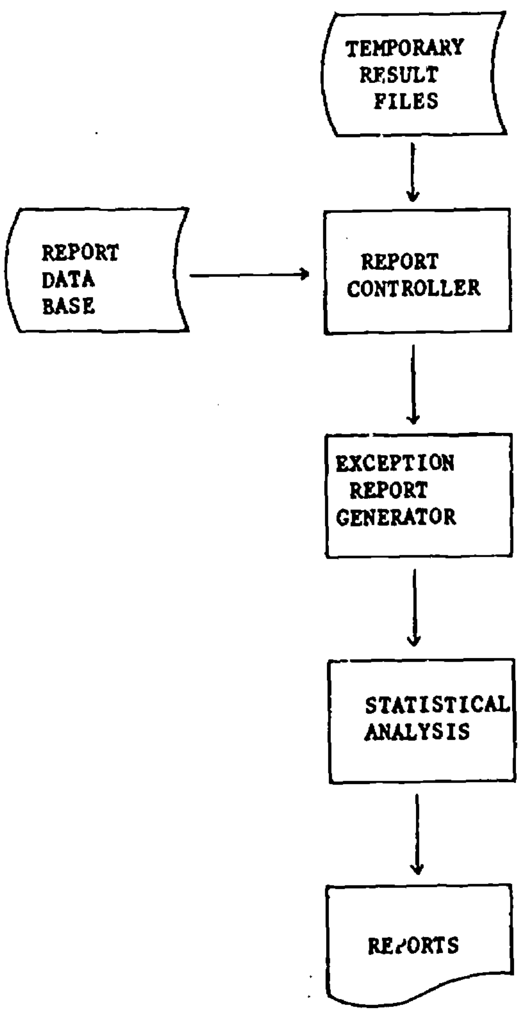


FIGURE 1 (cont'd)

CONNECT/CLASS

A Generalized Design

Phase 3 - Output System



8.2 THE INTERACTIVE PROMPTER AND SECURITY SYSTEMS

This system is the interface between a CONNECT/CLASS user and the actual operating programs. A user converses with the program by creating input commands that are transmitted to the operating routines. Before access to the system is allowed to a user he must be able to give the system a series of security codes. These codes would include a valid signon code so he may use the computer facilities, a valid code to allow him to use the simulator for a given school or school board and a code identifying him as one who is authorized to use the system. In this last case the code might simply consist of the user's name. The use of such codes prevents the access of unauthorized personnel to files which may be highly confidential in nature. For example, salary and budgetary data could well be considered confidential to all but a few users.

The prompter can be considered to operate in two modes:

(1) It can gradually guide the user from an area of interest to specification of a particular task.

(2) It can accept immediate task specifications from an experienced user. An example of the type of tasks that may be requested are shown on pages 14-16 Once the user has outlined his commands for the system, a file is created containing these commands for execution at a later date. Such a file of commands would naturally be carefully scanned to check for errors or invalid commands.

TYPICAL DIALOGUE

```
ENTER PROJ,USER,CU--AVW ,[redacted],A178*
 ENTER SEC
    [redacted]
 TYPE SYSTEM NAME --EDIT
 DATE = 08/28/70 TIME = 14/07/09  PORT  T064
   >DO,SCHOOL
SIGNON PLEASE:
?   INITIAL AVW
HELLO, THIS IS CONNECT/CLASS.
WHAT SCHOOL BOARD DO YOU REPRESENT?
?   TORONTO
 >>>
I'M SORRY, BUT I AM NOT FAMILIAR WITH THE BOARD OF TORONTO
WHAT SCHOOL BOARD DO YOU REPRESENT?
?   YORK
 >>>
WHAT IS YOUR NAME?
       ----
?   SMITH
 >>>
I'M SORRY, BUT YOU DO NOT HAVE CLEARANCE TO USE
CONNECT/CLASS, SMITH
PERHAPS YOU MISSPELLED YOUR NAME.  PLEASE TRY AGAIN:
WHAT IS YOUR NAME?
       ----
?   MR. GILLESPIE
 >>>
IT'S GOOD TO TALK TO YOU AGAIN MR. GILLESPIE
 >>>
WHAT WOULD YOU LIKE TO DO?
?   WHAT CAN I DO
YOU CAN SIMULATE, EXPERIMENT, REPORT, PRINT A REPORT, INPUT, UPDATE
OR EXECUTE A PREVIOUSLY PREPARED FILE.  PICK ONE.
?
```

```
WHAT CAN I DO
YOU CAN SIMULATE, EXPERIMENT, REPORT, PRINT A REPORT, INPUT, UPDATE
OR EXECUTE A PREVIOUSLY PREPARED FILE.  PICK ONE.
?   EXPERIMENT
 >>>
WHAT AREA WOULD YOU LIKE TO EXPERIMENT ON?
?   WHAT AREAS ARE THERE
YOU CAN EXPERIMENT ON SPECIFIC RESOURCES, ACTIVITIES, OR ENROLMENT...
OR YOU CAN ADD A PROGRAM.  PICK ONE.
?   ENROLMENT
 >>>
WHAT DO YOU WANT TO DO WITH ENROLMENT?
?   WHAT CAN I DO
YOU CAN CHANGE TOTAL ENROLMENT.
IN WHAT PROGRAM DO YOU WANT TO CHANGE THE ENROLMENT?
?   ALL PROGRAMS, PLUS 10%
WHAT YEARS SHOULD THIS EXPERIMENT COVER?
?   1969/74
I NOW HAVE ENOUGH INFORMATION FROM YOU TO EXPERIMENT.
WOULD YOU LIKE TO RUN THIS EXPERIMENT NOW OR
DO YOU WANT TO FILE IT AWAY FOR LATER USE?
       (ANS:    NOW      OR      LATER)
?   NOW
WHAT WOULD YOU LIKE TO CALL THIS EXPERIMENT?
?   ENROL.20
I WILL GO AHEAD AND TRY THIS EXPERIMENT.  YOU CAN FIND OUT
HOW IT'S DOING BY ASKING ME FOR THE STATUS OF ENROL.20
THE PRESENT
 TIME = 14/44/46
AND THE
 DATE = 08/28/70
WHAT ELSE WOULD YOU LIKE TO DO?
?   STATUS
WHAT NAME WOULD YOU LIKE TO CHECK THE STATUS ON?
?   ENROL.20
ENROL.20 IS PROGRESSING, BUT IS NOT YET FINISHED.
WHAT ELSE WOULD YOU LIKE TO DO?
```

```
WHAT CAN I DO
YOU CAN SIMULATE, EXPERIMENT, REPORT, PRINT A REPORT, INPUT, UPDATE
OR EXECUTE A PREVIOUSLY PREPARED FILE.  PICK ONE.
?   REPORT
WOULD YOU LIKE TO EXAMINE THE CATALOGUE OF REPORTS?
?   YES
          TITLE                       REPORT NO.
          -----                       ----------
SUMMARY REPORT-ENROLMENT               YORK1
SUMMARY REPORT-STAFF, SPACE
                EXPENDITURES           YORK2
STUDENT/TEACHER RATIO                  YORK3
STUDENT/TOTAL STAFF RATIO              YORK4
COST/STUDENT RATIO                     YORK5
INSTRUCTIONAL ROOMS REQUIRED           YORK6
ELEM. SCHOOL TEACHERS REQUIRED         YORK7
SYSTEM PROGRAM SCHEDULED HOURS         YORK8
WHAT REPORT DO YOU WANT?
?   SUMMARY ENROLMENT REPORT
FOR WHAT SCHOOLS OR COST CENTRES?
?   ALL SCHOOLS
FOR WHAT YEARS?
?   1969/74
FOR WHAT PREVIOUSLY RUN CASES?
?   ENROL.20
ANY MORE CASES?
?   NO
WOULD YOU LIKE TO SEE THIS REPORT NOW?
?   YES
WHAT WOULD YOU LIKE TO CALL THIS REPORT?
?   YORK1
```

Y O R K   B O R O U G H   B O A R D   O F   E D U C A T I O N

S U M M A R Y   R E P O R T - E N R O L M E N T

	1969/70	1970/71	1971/72	1972/73	1973/74
1. ELEMENTARY K - 6	12445	12819	13172	13951	13976
2. ELEMENTARY 7 + 8	3121	3109	3472	3705	3836
3. JR. KINDERGARTEN	486	1003	1026	1026	1026
4. SECONDARY 9 - 13	6694	6822	6710	7081	7136
5. PRIMARY OPPORT'Y	66	66	60	60	60
6. JUNIOR OPPORT'Y	83	115	80	80	80
7. INT. OPPORTUNITY	81	50	32	48	48
8. SLD - BEHAVIOR	20	15	8	8	8
9. SLD - PERCEPTUAL	7	0	40	48	48
10.CANADIAN C.C.	38	65	65	65	65
11.OCCUPATIONAL	462	474	538	614	678
12.SPEC. VOCATIONAL	260	254	257	260	263
T O T A L	23763	24792	25460	26946	27274

The benefits of such interactive prompting, conversing in an English language mode with immediate responses, are that a non-technical user who is unfamiliar with the system can quickly become experinced in handling the system and aware of the system's capabilities. On the other hand, an experienced user has the facility for by-passing all of the instructional aspects of the prompter and specifying a task to be performed immediately. Note should be made of the fact that the prompter is also designed to acquire information on how the system is being used, to provide the basis for adapting the design to make it both easier to use and more efficient.

8.3 INPUT SYSTEMS

The CONNECT/CLASS input routines ensure that data to be deposited in the file structures are both logical and correct. All input data are preceeded by verbal commands before editing and sorting to ensure maximum efficiency in processing. In other words, the routine processes and edits similar data together rather than manually.

Once the data have been sorted,they are then edited according to the following criteria:

(1) School and board parameters consisting of salaries, teaching loads, class sizes and so on do not exceed maximum and minimum levels.
(2) Data fall within system limits.
(3) Logical checks i.e. the organizational structure is complete, salaries attached to specific staff types,etc.

In order to ensure efficiency in input coding and editing the input routines operate on an "exception"basis. That is the user can put in a complete set of data or only additional data where exceptions occur from a basic set already stored. For example, if staff hiring policies were the same for all schools the user would only fill out one coding sheet for one general school and specify that this be applied to all schools.

The data requirements of the system are fairly comprehensive although not overbearing. A description of the input data may be found elsewhere in the Second Section of this report.

8.4 SIMULATION MODEL

The main CONNECT/CLASS planning tool is a simulation model that is capable of representing a specific institution under different academic and administrative plans and policies. The Class planning model represents a significant advance in planning capabilities. The model itself contains no built in biases since it is "data defined". It is not limited by the size of the institution or the level of aggregation of planning work requirements which are automatically assembled according to the user's requests from the interactive prompter. Only those routines necessary for desired analysis are included.

The simulation model is very flexible with respect to time horizons. A time period can be defined to be as short as one week although the normal period is one year. The degree of detail of the output of the simulation depends on the user's

definition of this time period and of an activity.

An activity is defined as any academic or administrative event that takes place within the institution and consumes resources. A user could define an activity as an individual course offering or possibly as a group of courses at a higher level of aggregation. Student counselling, health service delivery and examinations could also be defined as activities.

The experimental capabilities that are being designed for the new system are extensive and require no programing and very little additional data. These capabilities would be available to the user through the use of simple commands such as "INCREASED TOTAL ENROLLMENT PLUS 10%","INCREASED SALARIES 8% PER YEAR", and so on.

8.5 SUBSIDIARY AND STATISTICAL ANALYSIS

At this time we are in the process of determining what type of analysis should be made available to the user of the system. Such analysis should consist of an exception report capability and a standard set of statistical packages such as multiple regression, exponential smoothing and a complete BMD package. Further there will be some analysis available at the board level to determine how the system is being used, by whom and how frequently, and so on.

8.6 THE REPORTING SYSTEM

The CONNECT/CLASS report generator routines enable the user to choose from a wide variety of report structures. Combined with the capability of exception reporting, the user has a very wide range of report types from which to choose. Examples of the many different types of reports have been included throughout this presentation. Among the features included in the report generating system will be graphical methods, that is those designed to present either in graphical or histogram format, results that the user wishes to so display. It is frequently easier to determine the nature of a change in one specific variable by comparison with, for example, the base case through the use of a graph rather than a set of tables.

The next few pages contain general characteristics of the existing model, suggested subroutine design for a new system and a brief description of exception report capabilities and benefits.

8.7 PERMANENT FILE STRUCTURE AND EXCEPTION REPORT GENERATION

It is readily apparent that the use of a school system simulation model can occur at one or two levels. At the first level the model can be used to simulate a given school and perform experimentation upon the variables affecting that school. The second level is, of course, the board level. At this level it may be desirable to simulate individual schools, a number of individual schools, all the schools or, for the system as a whole. The size and complexity of the simulation model demands that considerable attention be paid to the permanent data base file structure and to the report generating structure in order to ensure that the work done is kept to a minimum.

The permanent data base for the model consists of all those variables that go into the make up of each individual school. It is important that this data base be completely verified as to its accuracy. Experimentation is performed by reading changes in the variables into temporary files such that the permanent data base is not affected by the results of the experimentation. If the data base consists only of those variables defining a school, then it is necessary to output in their entirety the results of that experiment. However, if the base case reports have been maintained in a permanent data report file then it becomes possible to generate only those reports which indicate the effects of modification to the variables in question. Therefore, ideally, the permanent data base consists of the two following files:

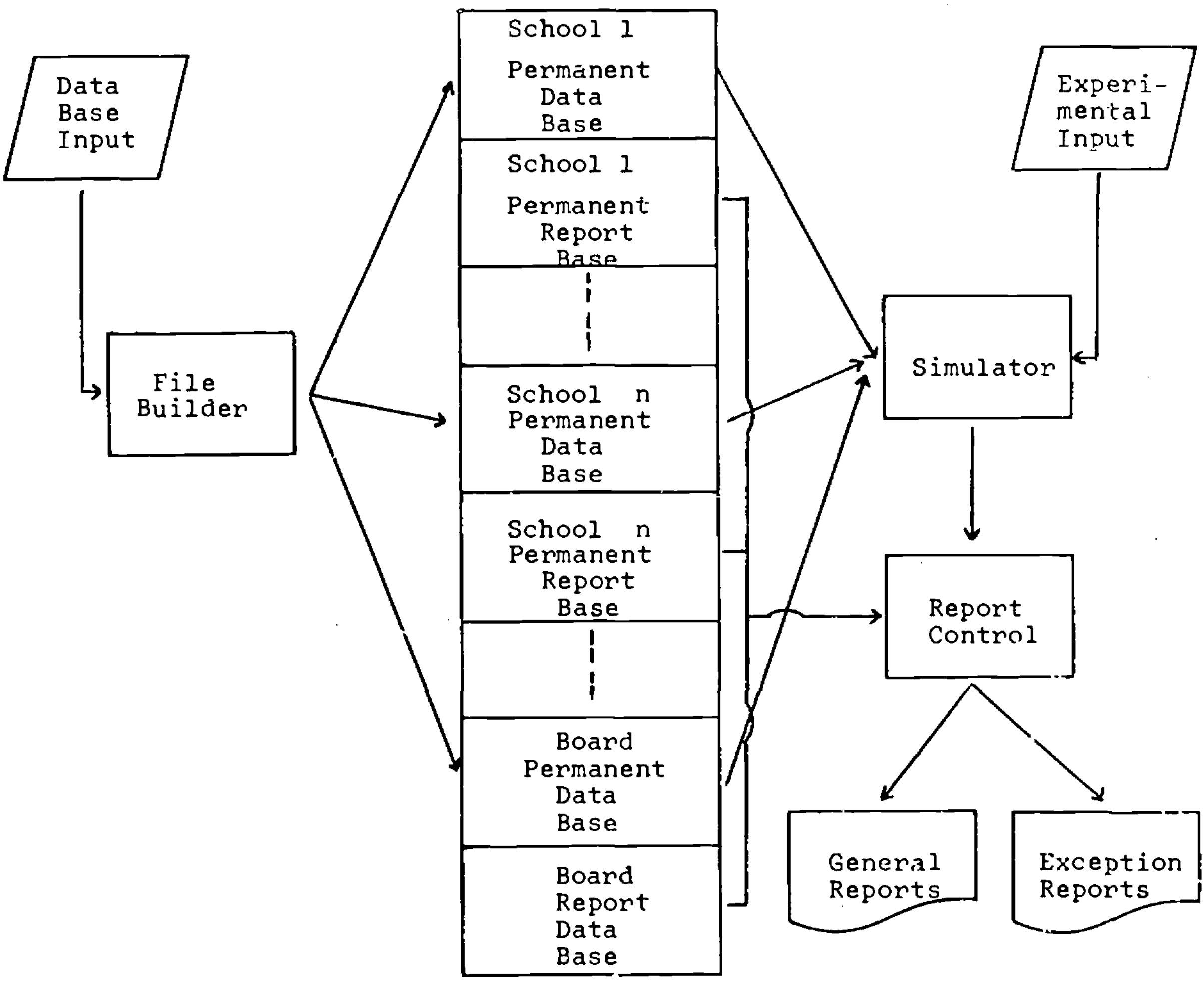
- The first file contains variables of enrollment, programs, resources, and so on that help define a school.
- The second file would consist of all the base case reports that are desired for that school.

These two files would then be maintained for every school in the school system. Thus, board reports could be readily generated simply by scanning individual reports for each school. Alternatively, if computer storage space were not at a premiur then all the reports necessary at the board level could also be maintained in the permanent data base. Such a file structure would enable the generation of exception reports, that is, reports which deal only with the variables that have been modified by experimentation. Not only does such a file structure help in the generation of exception reports but it also implies that the work done by the simulator can be kept to a minimum. For example, if one wished to change the section size at any given school and determine the effect that such a change would have at the board level, one would simply run the model for the school in question and from the base reports permanently on file, one would simply aggregate in order to determine the effects cn the board. Reference to Figure 1 indicates the type of file structure that would be required to maintain such a system. Note that the permanent data base consists of the two main files for each school. This includes the variables defining the school and the reports generated by such definitions. One additional advantage of such a design is that base case reports are available on demand without having to resort to the use of the simulator. Base case reports, therefore, are available at extremely low costs as they represent purely a reading of the files in question and the printing of those files.

Such a file structure also requires file maintenance programs, that is, programs that are designed to maintain and update the permanent data base wherever required. Whenever such a change to the permanent data base is required, the simulation

FIGURE 1

PERMANENT FILE STRUCTURE



model would have to run in order to revise the reports maintained in the permanent data base. However, these programs can be fast and extremely low in cost. In order to keep the cost of storage low and to provide ready access to the permanent data base, it would seem likely that one would desire to keep the data base on magnetic tape and at the time of use would simply transfer it to a higher speed access mechanism such as magnetic disc or drum.

It is quite important to realize the merits of exception reporting. At this point the model is not capable of producing exception reports but rather produces desired reports for each run. These reports would include analysis of all of the variables. In terms of time required to generate these reports, the time required to run the simulator, therefore, the model is not behaving in an efficient manner. It is quite feasible at this time to generate more than 60,000 lines of output each time that the simulator is run. It is easy to understand, therefore, that those in a position of making managerial decisions would not have the time to analyse such voluminous reports. Moreover, in order to fully utilize the model, substantial analysis of these reports has to be carried out. This normally is quite costly in terms of time and staff. The exception report, in contrast to what one might call the total report, is designed to be used by those making decisions and to present to them only those variables which have changed, either absolutely or by some given percentage. Such a system has several main advantages:

1. The amount of printing is significantly reduced thus saving on time and printing costs.
2. Information presented to the decision maker is in a form uniquely adapted to his purposes.
3. The decision maker's attention is immediately focused upon the variables of importance.

As has been mentioned before, exception reporting does require the type of file structure as shown in Figure 1. That is, in order to report changes to the actual base case, one simply compares the results of the simulation run with the base case for the particular school or board in question.

The above discussion clearly establishes the need to permanently maintain a base case for the purpose of comparison and exception report generation. At this time, we are studying the design for exception report generation and are hopeful of including such abilities in future simulation models of school systems.

9. CONCLUSION: ADVANTAGES OF COMPREHENSIVE PLANNING AND MANAGEMENT INFORMATION SYSTEMS

Connect/Class is a manifestation of the systems analytic approach to management and planning. The integration of complex factors into an analytical framework to make practical decisions is the essence of a systems analysis approach. The complexities of educational decisions can be characterized as follows:

- highly diverse investment choices
- complex inter-relationships
- long time periods to measure impact
- highly dynamic and uncertain environments
- measurement problems.

The long time period over which educational policies take effect increases the complexity of investment choices in a given year by the necessity of linking them with future and past decisions. In addition, they must wait for long periods prior to receiving any valuation of plans. A pure allocation may not only start a program in the wrong direction but it may also take years to acquire the experience and knowledge necessary to determine the appropriate corrections. Thus, it is extremely important that the implications of current decisions upon the future be carefully evaluated before a decision is finally made. Information on the future is fraught with uncertainty, but decisions have to be made in any case, and administrators should make their decisions in the light of the best information available. Connect/Class is an attempt to organize such information in a most meaningful way. It is recognized to be one of the most advanced systems that has been developed for this purpose.

The following points attempt to summarize the advantages that can be gained by using it.

9.1 PLANNING RATHER THAN RESPONDING

The ability to experiment with "alternative futures" should allow the planner to devise plans which are less sensitive to adverse turns of the wheel of fate. The simulation model can serve as a laboratory in which educational administrators can test alternative policies before decisions are made. The experimental resource of such testing can provide objective estimates of the resource implications of competing proposals. This information would be a healthy check on unsupported program proposals and would bring about more careful planning at all levels within the Board of Education. Better knowledge of the cost consequences of alternatives should improve decisions and reduce the number of unfortunate surprises in educational planning.

9.2 MORE COMPREHENSIVE JUSTIFICATION OF BUDGETS

The use of computerized simulation models makes possible accurate and substantiated statements of financial requirements. Heightened credibility of these statements combined with the demonstrable use of improved management tools should improve an institution's position in supporting sound expenditures and public funds. The results of the simulation can be presented either in traditional budgetary format, or in such a way as to juxtapose program levels and associated cost. A particular advantage of the model is its ability to compute the incremental cost of altering each activity level. This should facilitate efficient allocation of the resources of school boards and public funds. An important advantage which appears as a by-product in the budget-making process is the extent to which Connect/Class should reorient top level budgetary negotiations from concentration upon aggregate dollar magnitudes towards the underlying decisions which are of a more fundamental importance.

9.3 QUICKER, CHEAPER, LESS TEDIOUS PLANNING

Laboriously produced "master plans" are often obsolete before the ink is dry. Simulation models permit continuous planning in response to change circumstances and opportunity. Finally, the use of such models obviates the investment of scarce managerial time and talent in small, manual computations. Because of a paucity of information, an impending decision of any consequence in a school system is likely to initiate a search for new data. Each time there is a search, it places a redundant burden on the principals of individual schools as they strive to supply requested information. Because these data are often supplied on a tight time limit, the quality is frequently dubious. Typically,the results of one survey are unavailable or innappropriate to the next. Such a procedure is wasteful and cannot provide uniformly good information. Because it systematically brings together and analyses information relative to a broad class of problems, the simulation model should reduce the burden of tedious and repetitious paper work.

9.4 AIDING PRINCIPALS IN THE ESTABLISHMENT OF NEW SCHOOLS

Schools in the early growth stage stand to profit greatly from the use of simulation models. The range in decision variables is so broad and the importance of early decision so great that the planners deserve all the assistance that they can get. The design and use of the simulation model in the formulative stages of school planning may avoid costly errors and waste from new educational investment.

9.5 AIDING FUNDING AGENCIES

The task of planning with the financial requirements of the Toronto Metropolitan School System can be greatly facilitated by objective analysis of the type obtainable from the simulation models.

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